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GUIDELINES FOR AIR QUALITY MAINTENANCE PLANNING AND ANALYSIS. VOLUME 13. ALLOCATING PROJECTED EMISSIONS TO SUBCOUNTY AREAS

Environmental Protection Agency

PREPARED FOR
Argonne National Laboratory

November 1974

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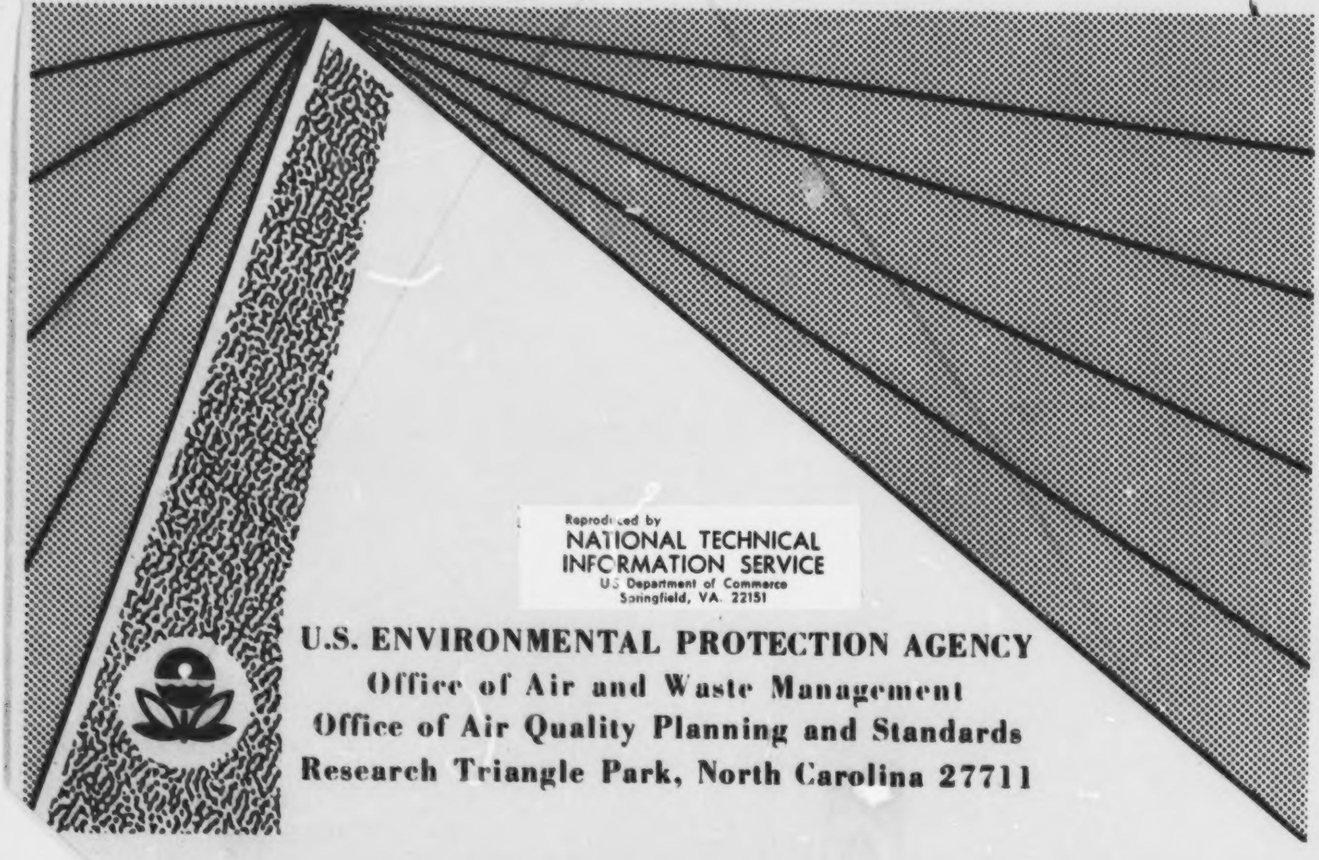
/VOLUME 13:/

ALLOCATING PROJECTED EMISSIONS TO SUB-COUNTY AREAS



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16. ABSTRACT

This document describes a methodology for projecting and allocating pollutant-specific emissions to areas that are smaller than counties. Three Orders of analysis requiring successively more detailed data and more extensive levels of effort are treated. The techniques advanced rely upon the development of demographic and economic projections that are used as surrogates to forecast source-specific emissions resulting from residential fuel combustion, transportation, commercial and institutional fuel combustion, industrial processing and fuel combustion, and solid waste incineration. Procedures for allocating emissions to large subcounty areas (e.g., municipalities, townships, census tracts and/or regional planning activities, etc.) are treated first. Total emissions from each source are then apportioned to square cells in a master grid system. Emissions allocated to these cells in a master grid system are the final output of this technique and can be used as input for the purpose of modeling air quality.

Appendices A and B illustrate a test of these procedures applied to Fulton County (Atlanta), Georgia. The results of this test case demonstrates that the Order 3 procedures yield the most refined estimates of emissions allocated to subcounty areas and prospective users are encouraged to employ these procedures wherever the availability of detailed data and manpower resources permit.

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VOLUME 13:
ALLOCATING PROJECTED EMISSIONS TO SUB-COUNTY AREAS

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OAQPS GUIDELINE SERIES

The guideline series of reports is being issued by the Office of Air Quality Planning and Standards (OAQPS) to provide information to state and local air pollution control agencies; for example, to provide guidance on the acquisition and processing of air quality data and on the planning and analysis requisite for the maintenance of air quality. Reports published in this series will be available - as supplies permit - from the Air Pollution Technical Information Center, Research Triangle Park, North Carolina 27711; or, for a fee, from the National Technical Information Service, 5285 Port Royal Road, Springfield, Virginia 22161.

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FOREWORD

This document is the thirteenth in a series comprising *Guidelines for Air Quality Maintenance Planning and Analysis*. The intent of the series is to provide State and local agencies with information and guidance for the preparation of Air Quality Maintenance Plans required under 40 CFR 51. The volumes in this series are:

Volume 1: *Designation of Air Quality Maintenance Areas*
Volume 2: *Plan Preparation*
Volume 3: *Control Strategies*
Volume 4: *Land Use and Transportation Consideration*
Volume 5: *Case Studies in Plan Development*
Volume 6: *Overview of Air Quality Maintenance Area Analysis*
Volume 7: *Projecting County Emissions*
Volume 8: *Computer-Assisted Area Source Emissions Gridding Procedure*
Volume 9: *Evaluating Indirect Sources*
Volume 10: *Reviewing New Stationary Sources*
Volume 11: *Air Quality Monitoring and Data Analysis*
Volume 12: *Applying Atmospheric Simulation Models to Air Quality Maintenance Areas*
Volume 13: *Allocating Projected Emissions to Sub-County Areas*

Additional volumes may be issued.

All references to 40 CFR Part 51 in this document are to the regulations as amended through July 1974.

PREFACE

The methodology described in Allocating Projected Emissions to Subcounty Areas is integral to the preparation of Air Quality Maintenance Plans required under 40 CFR 51. The three methods detailed in this volume are discriminating enough to permit a high level of refinement in developing emission inventories for subcounty areas.

Three Orders of progressively more refined allocation procedures are described for each of the five categories of emission sources treated in previous volumes of the Guidelines for Air Quality Maintenance Planning and Analysis. The procedures described in this volume are directly integrated with those detailed in Volume 5: Case Studies in Plan Development, Volume 7: Projecting County Emissions, and Volume 8: Computer-Assisted Areas Source Emissions Gridding Procedure. The procedures described in this document are subject to modification and/or revision. To date, however, they represent the best available techniques for allocating emissions to areas smaller than counties and should be applied to all AQMAs where required emission projections are needed on either short- or long-term bases.

In order to obtain from this procedure the most refined estimates of projected emissions, the user is encouraged to employ the highest allocation Orders for which data are available (e.g., Order 3). This means that data will have to be assembled from a variety of governmental agencies and that a substantial amount of hand calculation will be necessary in most cases.

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1.0 INTRODUCTION

The air quality maintenance task undertaken by the U.S. Environmental Protection Agency is designed to ensure that the National Ambient Air Quality Standards are maintained after their scheduled attainment date of May 31, 1975 or May 31, 1977. The program is designed to consider the impact of future growth and development on air quality and to develop control strategies, where needed, to ensure that air quality will not deteriorate from the standards.

A horizon of ten years was chosen as being the most reasonable time frame for accurately forecasting growth. The states have the responsibility for determining specific areas, Air Quality Maintenance Areas (AQMA), where growth presents a potential threat to air quality and of assuring that considerations for the control of this growth are included in the State Implementation plans (SIP) for these areas.

As part of the preparation of an Air Quality Maintenance Plan, the states are required to project emissions and resultant air quality for each AQMA. Where the analysis indicates the existence of potential violations of standards, control strategies must then be designed for each AQMA or subarea within the AQMA. To date, the EPA has had prepared a 12-volume set of Guidelines detailing procedures for developing an Air Quality Maintenance Plan. Projecting County Emissions: Volume 7 has dealt with techniques for projecting emissions for each county within an AQMA at 5-year intervals, from 1975 to 1985. And Computer-Assisted Area Source Emissions Gridding Procedure: Volume 8 details some initial work that has been done toward developing a methodology to distribute projected emissions to subcounty areas. The main purpose of this report, which complements and supplements the above guidelines, is to establish additional emission allocation techniques for subcounty areas and to recommend methodologies for their use.

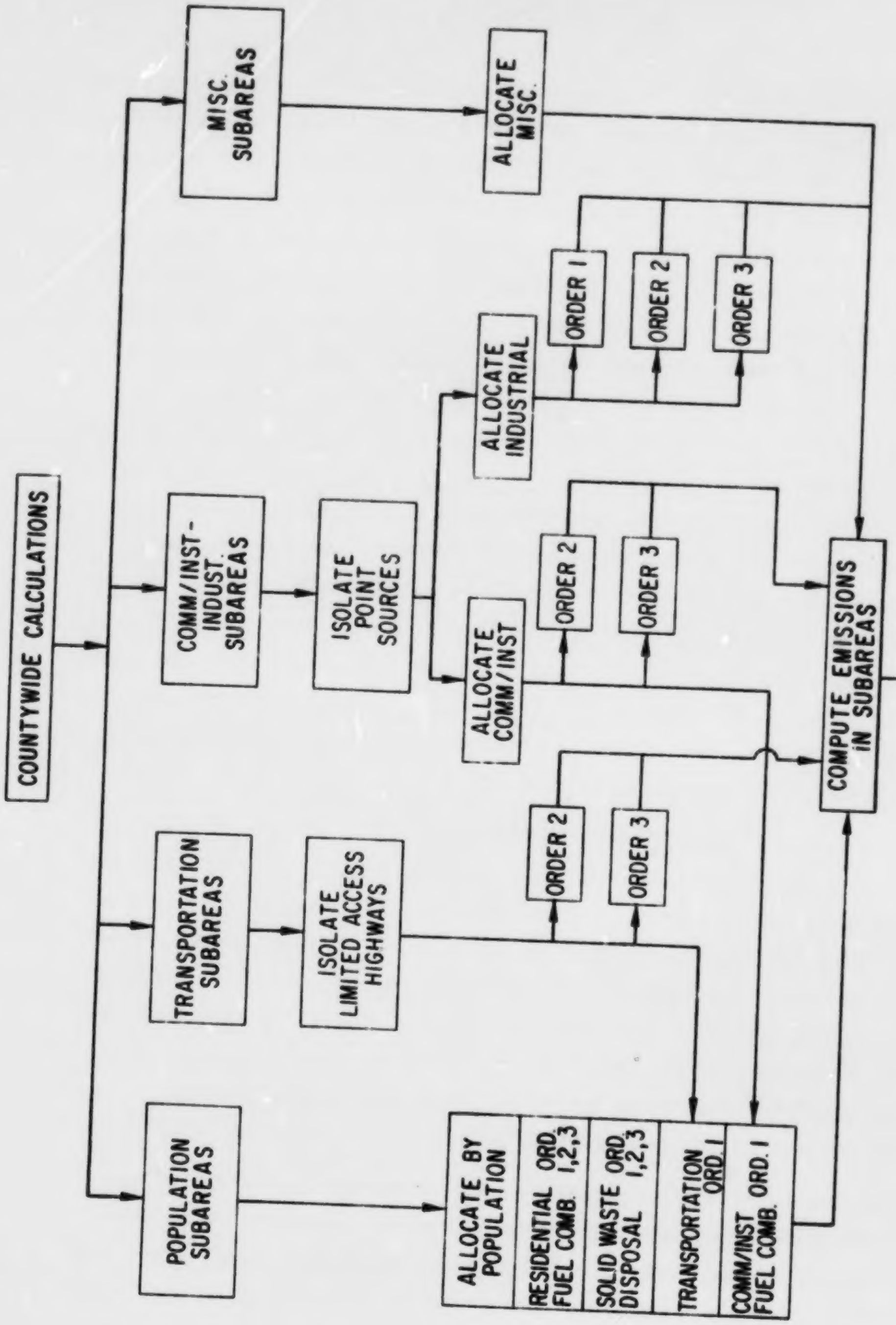
The principal objective of this work, therefore, is to provide a technique for allocating projected countywide air pollutant emissions to subcounty areas. This allocation is to be achieved through use of available data bases for subcounty units, with adjustments for expected reductions due to air quality maintenance regulations. The development of allocation techniques is subject to three major constraints: (1) the agencies responsible for maintenance planning (usually the state air pollution control agency) are faced with potentially serious limitations of time, manpower, and finances available for this work; (2) sophisticated computer capability may not be available to the responsible agency; and (3) allocation methodologies must be sufficient to withstand legal and technical challenges to the techniques advanced. In light of these constraints, the following approach is directed at providing a technically adequate procedure for Air Quality Maintenance Planning. The appendix of this report provides the results of a field test undertaken to evaluate the techniques presented. Techniques that do not require computer facilities, as well as the more complex computer-assisted procedures, are described. This is done so that an agency may choose the set of procedures best suited to its capabilities and resource constraints.

2.0 SCOPE AND STRUCTURE

Figure 2.1 indicates the structural outline and scope of the subcounty allocation procedure. It is assumed that the responsible air quality maintenance planning agency will have completed the data acquisition and emission projection procedures for all counties within the AQMA prior to performing the subcounty allocation. These procedures have been detailed in Projecting County Emissions: Volume 7 of the Guidelines. In proceeding to the subcounty allocation it must be recognized that while additional data may need to be gathered some of the necessary data may already be on hand as a result of the countywide analysis. To avoid redundancy and unnecessary effort in assembling data, it is recommended that the agency be completely familiar with both the countywide emission projection procedures and the subcounty allocation techniques before proceeding with any analysis. It must also be noted that in some cases the direct development of subcounty emission estimates may supersede or obviate the need for countywide estimates, as more detailed data are needed to do the subcounty allocation. In such cases, the emissions allocated to subcounty areas may not add up to the previously computed countywide emissions. Whichever data base (either countywide or subcounty area) is determined to be the more reliable should be used as the standard, and the other should be appropriately adjusted to it.

The subcounty allocation procedure takes place in four distinct stages: (1) population-based, (2) transportation-based, (3) commercial/institutional-industrial-based, and (4) miscellaneous. The separation of these four stages allows the agency to perform the allocation using several different types of available data bases, each of which may use different subareas for displaying information. Data from each of the stages are combined consistent with a master grid system after the emissions from each type of source have been calculated. This procedure grants the agency maximum flexibility in making use of the best available data.

Three calculation techniques are described for each stage of the emissions allocation procedure. These techniques are referred to as Order 1, 2, or 3 procedures to indicate increasing levels of detail, complexity, and accuracy. It is strongly emphasized that these do not correspond one-to-one to the Level 1, 2, 3 analyses described in Projecting County Emissions: Volume 7


COUNTYWIDE CALCULATIONS
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COMM/INST-INDUST. SUBAREAS
MISC. SUBAREAS
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ISOLATE POINT SOURCES
ALLOCATE MISC.
ALLOCATE INDUSTRIAL
ALLOCATE COMM/INST
ORDER 1
ORDER 2
ORDER 3
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ORDER 3
ORDER 2
ORDER 3
ALLOCATE BY POPULATION
RESIDENTIAL FUEL COMB. ORD. 1,2,3
SOLID WASTE DISPOSAL ORD. 1,2,3
TRANSPORTATION ORD. 1
COMM/INST FUEL COMB. ORD. 1
COMPUTE EMISSIONS IN SUBAREAS
MASTER GRID ALLOCATION

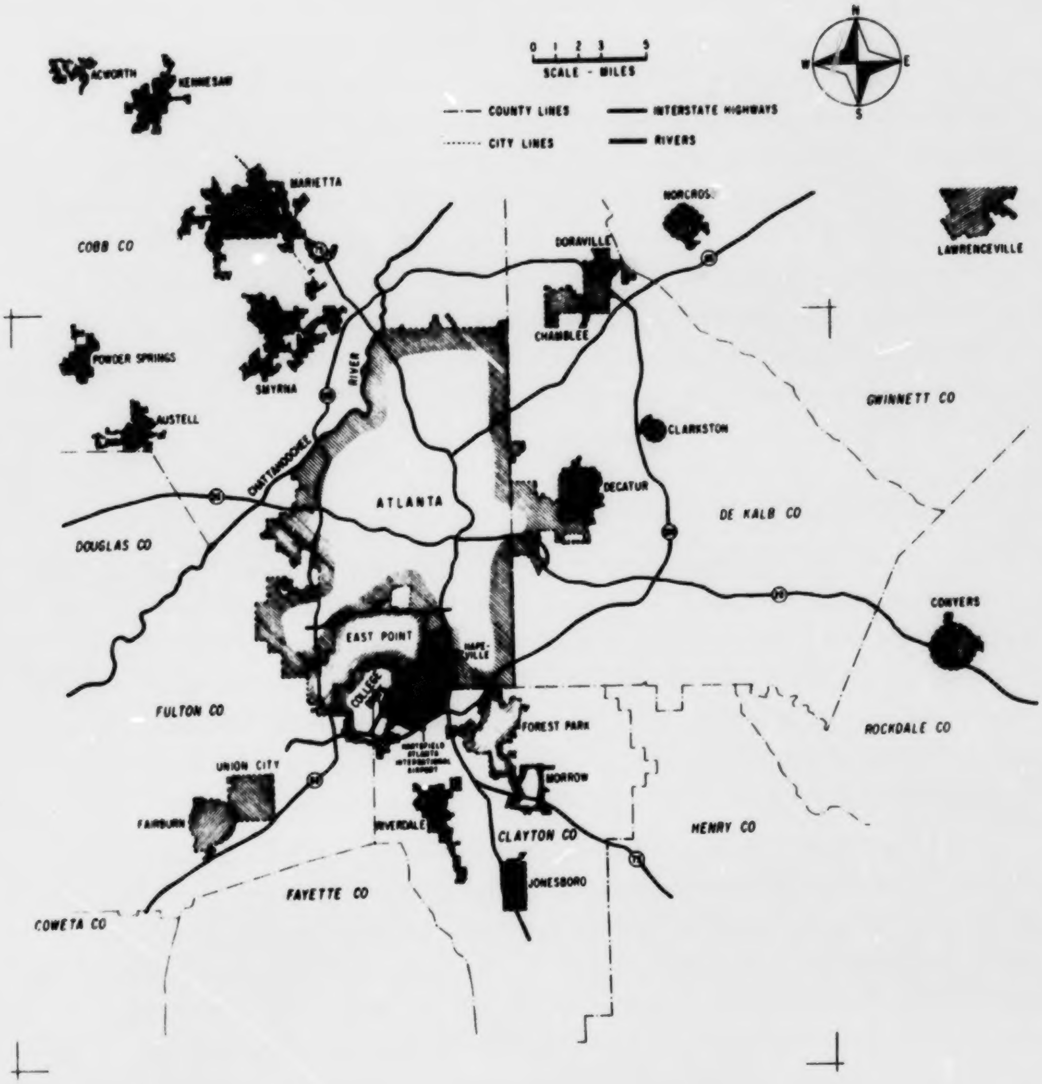
Figure 2.1 Program Scope and Structure

of the Guidelines. For example, in preparing a Level 2 countywide emission projection scheme, it is not essential, or necessarily desirable, to proceed with an Order 2 subcounty allocation. In the same vein, it is not mandatory to maintain the same order through all stages of the subcounty allocation. It is entirely reasonable to do an Order 2 population-based allocation and an Order 3 transportation-based allocation. Criteria for choosing the appropriate allocation order are suggested for each stage, but, in general, the allocation order should be chosen to fit the most detailed data that are readily available and commensurate with the air quality maintenance problem. There is, however, some correspondence between the Levels of the countywide projections and the subcounty Orders. It is not reasonable to perform a Level 1 countywide emission estimate (the least detailed and accurate) and then perform an Order 3 subcounty emission allocation (the most detailed and accurate). The connections must be determined separately for each stage and emission source.

2.1 POPULATION-BASED ALLOCATION

There are a number of sources whose emission distribution may be linked directly to the population distribution within the county being considered. For each county there are several different geographical descriptions of population distribution, any of which may be used. The U.S. Censuses of Population and Housing provide the most widely available demographic data, although some areas have a regional planning commission, which substantially amplifies the resolution of the Census Bureau's projection data.

The types of subcounty areas include municipalities, census tracts, Master Enumeration Districts, regional planning districts, and townships. In every area there are population data available on at least a municipality basis (Figure 2.2). This information is tabulated in the Census of Population for all places containing a population of 2500 or more. The geographical location of these municipalities may be found either in the census publications or on regional maps. It should be noted, however, that the municipalities may not cover an entire county, since there may be extensive unincorporated areas. In these cases, the total of the municipality populations is subtracted from the total county population (also tabulated by the Census Bureau) to determine the residual county population (the number of people living outside of munici-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CHAMBLEE
LAWRENCEVILLE
GWINNETT CO
CLARKSTON
DECATUR
ATLANTA
DE KALB CO
DOUGLAS CO
CONYERS
EAST POINT
HAPEVILLE
COLLEGE PARK
FULTON CO
FOREST PARK
HARTSFIELD ATLANTA INTERNATIONAL AIRPORT
ROCKDALE CO
UNION CITY
MORROW
FAIRBURN
RIVERDALE
CLAYTON CO
HENRY CO
JONESBORO
FAYETTE CO
COWETA CO

Figure 2.2. Municipality Subcounty Area Display

pal boundaries). This selection of subareas will generally result in delineating a small number of districts within each county, and population-based allocations can easily be handled without a computer.

For most large, urbanized areas, the region is subdivided into tracts by the Census Bureau (Figure 2.3). These tracts, while lying within county boundaries, do not necessarily lie along municipal boundaries and may overlap several political jurisdictions. The tracts are large in the less densely populated areas and small in centers of population concentration. Because tracts are delineated according to population density, they portray the distribution of a county's population at a high degree of resolution. Nevertheless, choice of census tracts as the population-based subareas must be made with careful consideration. In some regions the number of tracts, though larger than the number of municipalities, is still small enough to be managed without computer assistance (the Atlanta SMSA has 238 tracts). On the other hand, some regions have a large number of tracts, which make hand computations unwieldy (the Chicago SMSA has over 1500 tracts). Census tracts should therefore be used as subcounty areas only when sufficient computational resources are available and good detail is needed.

Master Enumeration Districts are essentially the same as census tracts in areas that are tracted and have other definitions in untracted areas. Data for these districts are tabulated on magnetic tape that is available from the Census Bureau. A set of computer programs has been written to enable one to process this information and to develop a grid system for the allocation of area source emissions. These programs and gridding procedures are documented in Computer-Assisted Area Source Emissions Gridding Procedure: Volume 8 of the Guidelines. Areas in which there are active regional planning commissions will usually be subdivided into planning districts that the commissions use for displaying data. In some areas, these planning districts lie along municipal or census tract boundaries. In other areas, they are drawn up to meet the specific requirements of a particular commission and do not correspond to any other subarea definition.

In most areas of the county, a political jurisdiction, referred to as a township, is superimposed on existing municipal jurisdictions (Figure 2.4). The townships are normally square-gridded with 36 square-mile-sections in each. These townships can be used as regional planning districts, as in Northern Illinois.

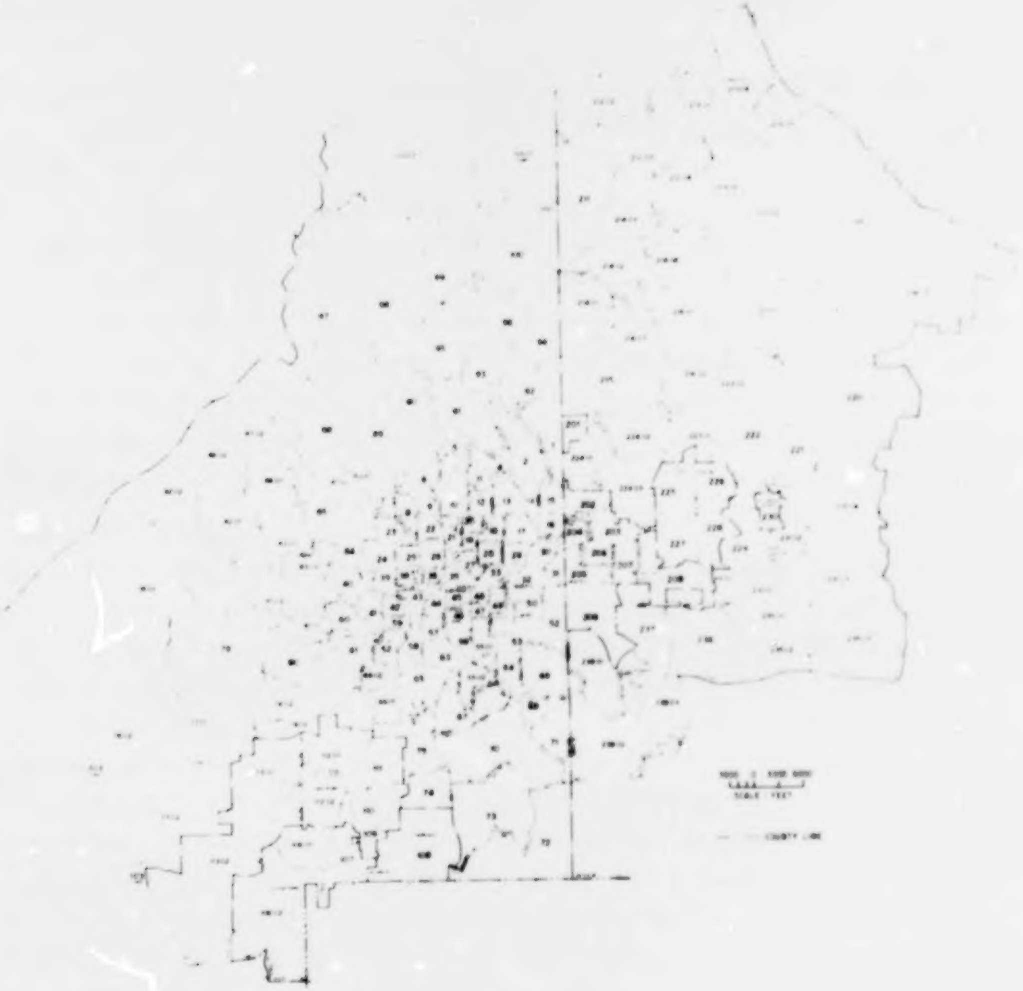
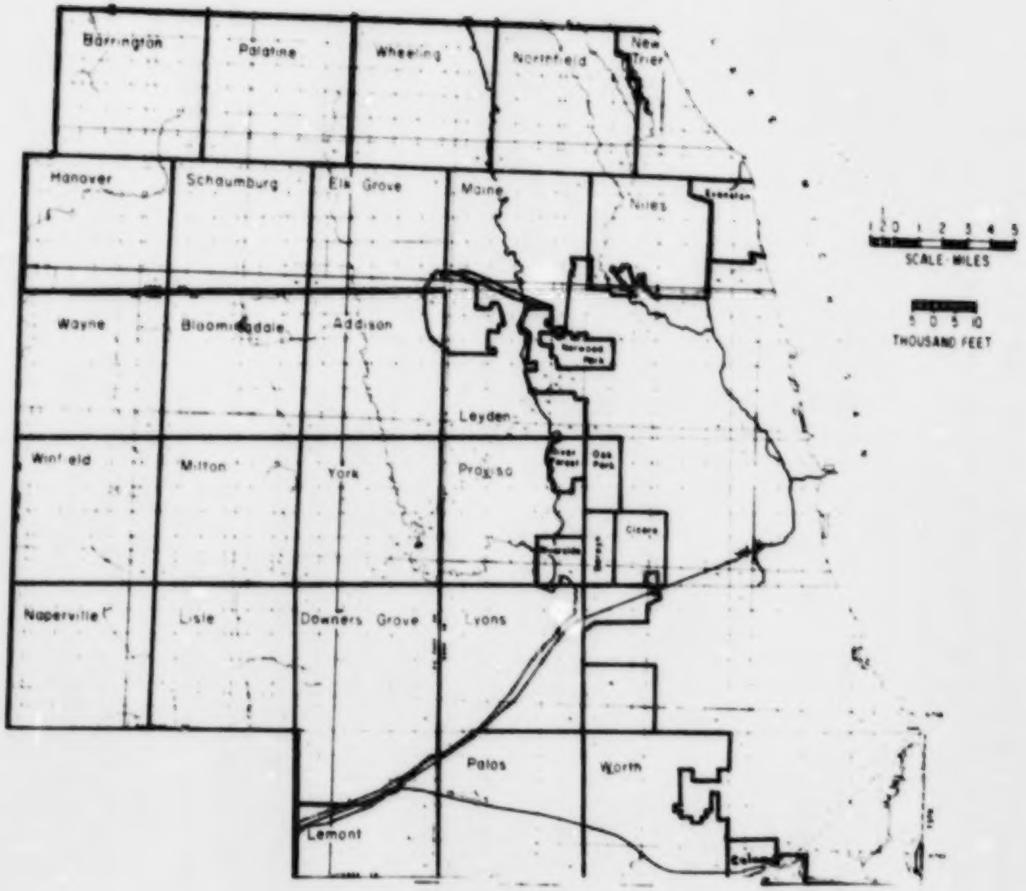


Figure 2.3. Census Tract Subcounty Area Display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Leyden
Winfield
Milton
York
Proviso
Oak Park
Cicero
Naperville
Lisle
Downers Grove
Lyons
Palos
Worth
Lemont
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THOUSAND FEET

Figure 2.4. Township Subcounty Area Display

The main conclusion to be drawn from this discussion is that there are a variety of subcounty areas for which population distribution information is displayed. In any given region, there may be more than one subarea set. Choice of the appropriate set of subareas for use in allocating emissions is based on identifying which one contains the most detailed set of information and yet is manageable within the resources of the planning agency charged with maintaining air quality. It is recommended that the subareas to be used for the transportation allocation and the commercial/institutional-industrial allocation be investigated prior to making a final choice to allow for the possibility that one subarea set may provide information for other stages of the analysis.

2.2 TRANSPORTATION-BASED ALLOCATION

As with the population-based subcounty areas, there are a number of subarea sets available for describing the distribution of transportation systems. In some areas of the country, the transportation planning agency may use one of the regional planning grids for developing its data base, in which case the population-based subareas and the transportation-based subareas can be selected as being one and the same.

In other regions, the transportation planning grid may be developed separately as in the Chicago area (see Figure 2.5). This separation presents no unusual problems in the allocation procedure, and there is no need at this point to try to convert one grid system to another.

Some regions will have no grid system that is used for transportation-related data display and all that will be available will be highway department road maps. This is the case in Clayton County, Georgia (Figure 2.6). In most areas where this situation prevails, vehicle count data will be available only for the major expressways and busy arterials.

In some instances, however, the state transportation department will have developed traffic data on a link-by-link basis as part of the Continuing, Comprehensive, and Coordinated (3-C) transportation planning process. The links will generally be described by the UTM coordinates for their end points and have vehicle count data on them.

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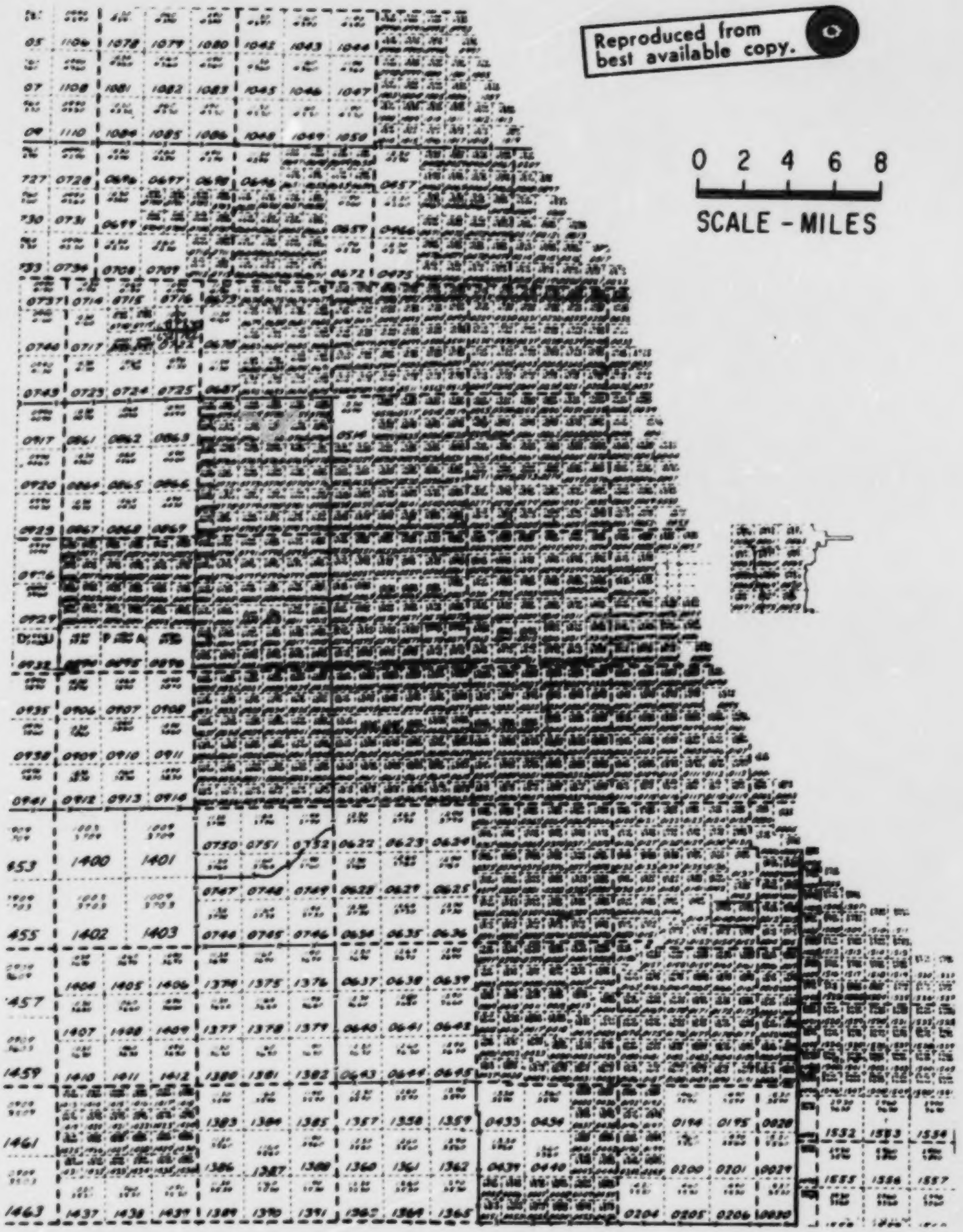
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SCALE - MILES

Figure 2.5. Transportation Planning Grid Subcounty Area Display

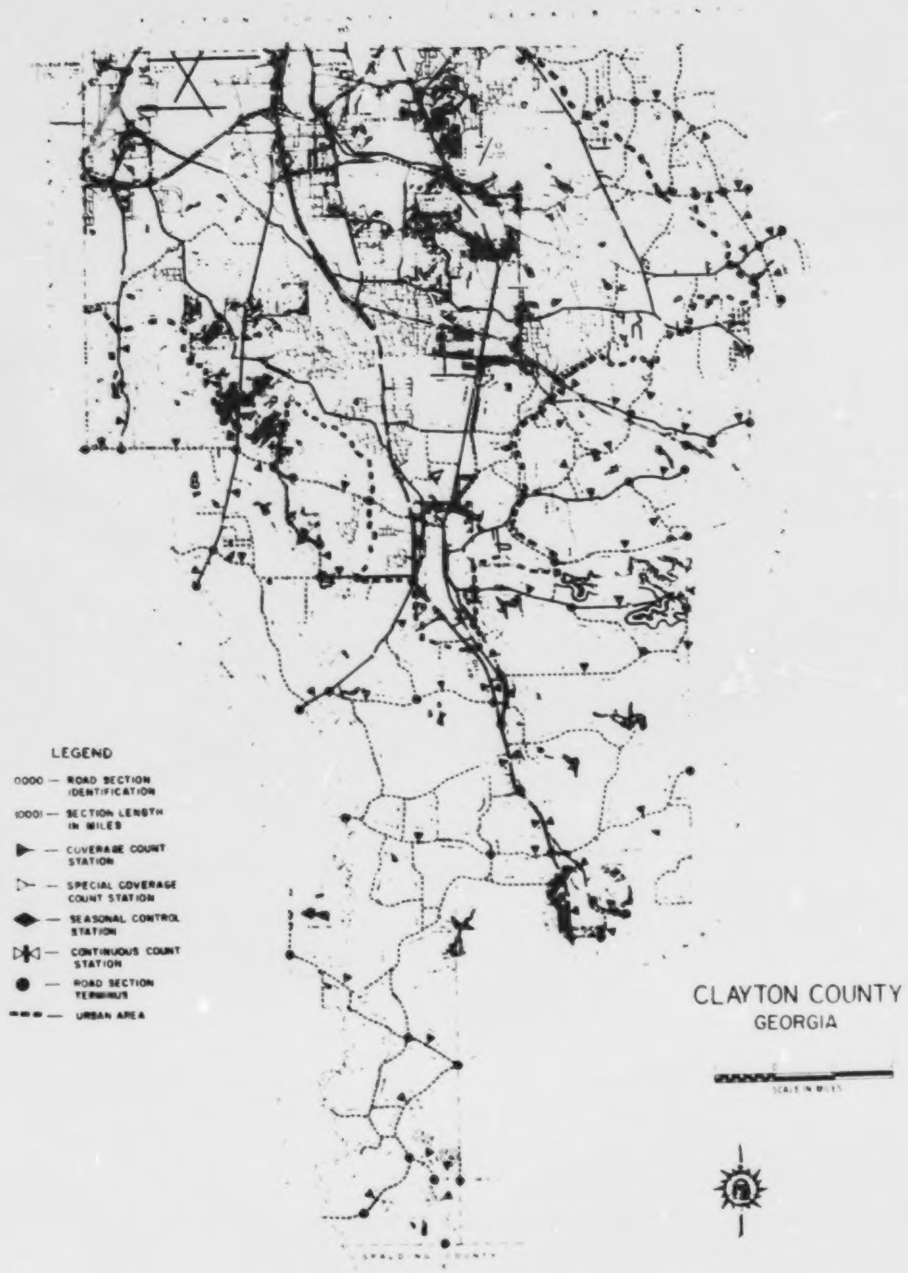
LEGEND
0000 — ROAD SECTION IDENTIFICATION
0001 — SECTION LENGTH IN MILES
▶ — COVERAGE COUNT STATION
▷ — SPECIAL COVERAGE COUNT STATION
◆ — SEASONAL CONTROL STATION
▷◁ — CONTINUOUS COUNT STATION
● — ROAD SECTION TERMINUS
- - - — URBAN AREA
CLAYTON COUNTY
GEORGIA
SCALE IN MILES
SPALDING COUNTY

Figure 2.6. Highway Department Road Map

2.3 COMMERCIAL/INSTITUTIONAL-INDUSTRIAL-BASED ALLOCATION

The display of commercial/institutional-industrial data is generally in one of the forms previously described, such as census districts, regional planning districts, or townships. An additional information display may be a land use map of the area (Figure 2.7) on which the various land uses are coded to indicate the distribution of activity. While this type of presentation does not rely on a grid network, it can nevertheless provide useful data for the analyses described in Sections 2.3 and 3.4.

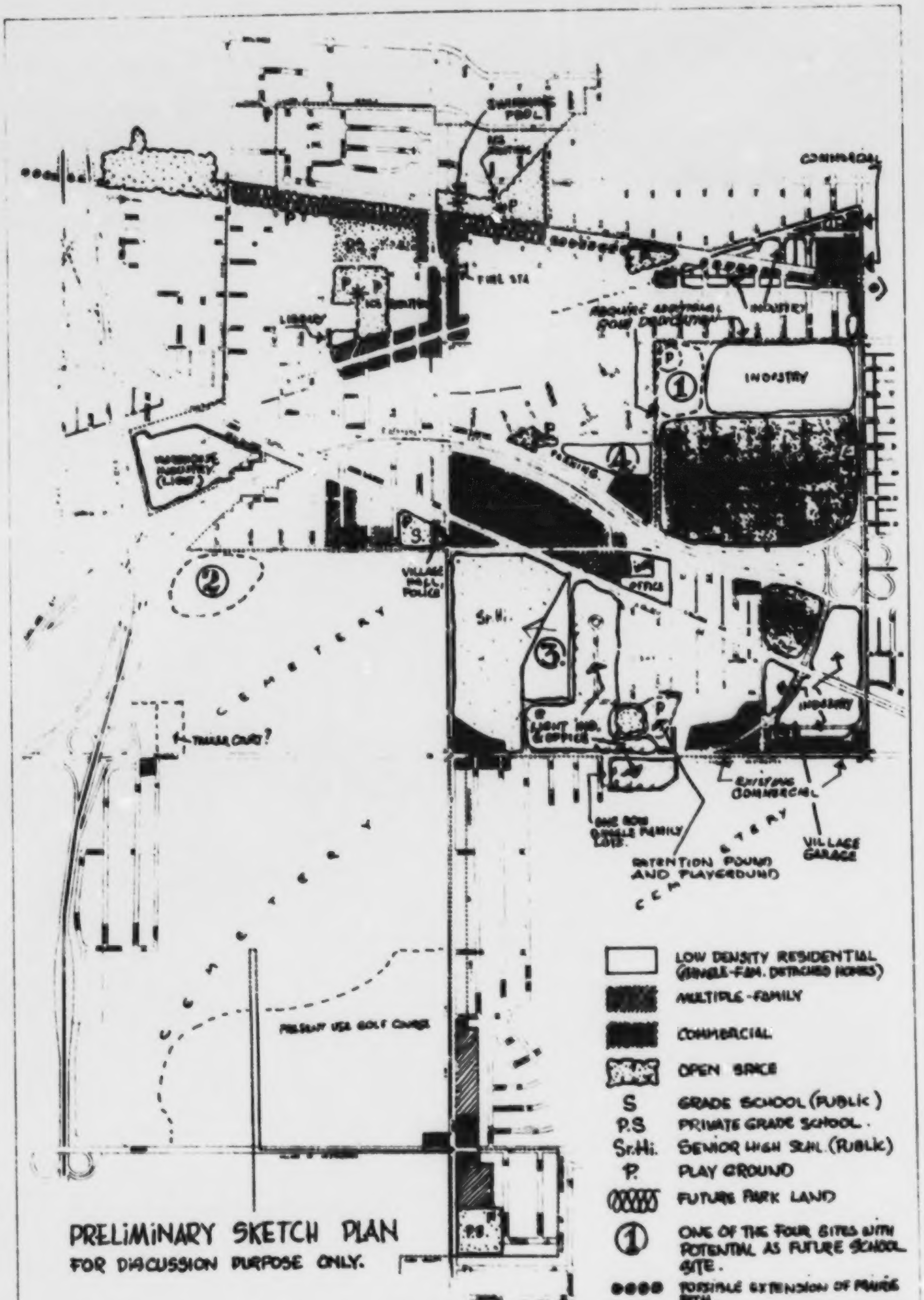
PRELIMINARY SKETCH PLAN
FOR DISCUSSION PURPOSE ONLY.
VILLAGE OF HILLSIDE ILLINOIS
PLANNING CONSULTANTS - COLLABORATIVE RESEARCH & PLANNING INC CHICAGO
LOW DENSITY RESIDENTIAL (SINGLE-FAM. DETACHED HOMES)
MULTIPLE-FAMILY
COMMERCIAL
OPEN SPACE
S GRADE SCHOOL (PUBLIC)
P.S PRIVATE GRADE SCHOOL.
Sr.Hi. SENIOR HIGH SCHL. (PUBLIC)
P. PLAY GROUND
FUTURE PARK LAND
① ONE OF THE FOUR SITES WITH POTENTIAL AS FUTURE SCHOOL SITE.
POSSIBLE EXTENSION OF PRAIRIE PATH.
300 0 300 900 1500
FEET
COMMERCIAL
INDUSTRY
FIRE STA
LIBRARY
SWIMMING POOL
PARKING
VILLAGE HALL POLICE
OFFICE
LIGHT IND. & OFFICE
EXISTING COMMERCIAL
VILLAGE GARAGE
RETENTION POUND AND PLAYGROUND
ONE ROW SINGLE FAMILY LOTS
TRAILER COURT?
PRESENT USE GOLF COURSE
CEMETERY
INDUSTRY (LIGHT)
P.S.
S.
Sr.Hi.
①
②
③
④

Figure 2.7. Land Use Map

3.0 EMISSION SOURCES

In discussing the allocation of air pollutant emissions, the following source categories will be treated: residential fuel combustion, transportation, commercial/institutional fuel combustion, industrial process and fuel combustion, solid waste disposal, and miscellaneous sources. It should be noted that evaporative hydrocarbon emissions are not discussed because of the decision that hydrocarbons and nitrogen oxides will be treated on an AQMA-wide basis rather than on a county or subcounty basis. By the same token, it will not be necessary to go through the following subcounty allocation procedures for hydrocarbons and nitrogen oxide emissions from other sources. Nevertheless, in the interest of allowing for a change in policy, columns for these pollutants have been included on the tables.

3.1 RESIDENTIAL FUEL COMBUSTION EMISSIONS

3.1.1 Introduction

The combustion of fuel for space heating in residential buildings is a ubiquitous source of emissions that can be directly related to population distribution. The three Orders of successively more complex allocation techniques rely on population and/or dwelling unit distributions to allocate emissions among the subcounty areas. These techniques will depend upon the choice of a population subcounty area data base from among those described in Section 2.1.

3.1.2 Data Requirements

Data required for each of the three allocation Orders are as follows:

Order 1:

a. Actual and projected population for each specified area. (Sources: U.S. Census of Population; state, regional, and local planning agencies.)

b. County totals (actual and projected) of fuel used for residential space heating. (Source: Table 3.1, Projecting County Emissions: Volume 7 of the Guidelines.)

Order 2:

a. Actual and projected dwelling units for each specified subcounty area. (Sources: *U.S. Census of Housing*; state, regional, and local planning agencies.)

b. County totals (actual and projected) of fuel used for residential space heating. (Source: same as for Order 1.)

Order 3:

a. Actual and projected number of dwelling units for each specified subcounty area. (Sources: same as for Order 2.)

b. Actual and projected residential building size distribution (classified by the number of dwelling units per building size) for each specified subcounty area. (Sources: *U.S. Census of Housing*, state, regional, and local planning agencies.)

c. Actual and projected residential fuel use distribution for each specified subcounty area. (Sources: *U.S. Census of Housing*, utility companies, state, regional, or local planning agencies.)

d. Total degree-days for the region under study. (Source: *Climatic Atlas of the United States*.)

3.1.3 Procedural Overview

The first two allocation orders start from the premise that the countywide residential fuel use, broken down by fuel type, is known from the analysis described in *Projecting County Emissions: Volume 7* of the Guidelines. Distributions of population (Order 1) or Dwelling Units (Order 2) are determined for the chosen subcounty areas and the countywide fuel use totals are apportioned accordingly. For an Order 3 allocation, the number of dwelling units, building size distribution, fuel use distribution, and local degree-day totals are used to compute a fuel requirement for each subcounty area. The total of the areas is then checked against the county total to ensure capability.

Each allocation order is discussed below in a separate subsection in which all of the procedures are spelled out in step-by-step fashion. It is recommended that the user become familiar with all of the allocation orders. Some tolerance for repetition will be rewarded with an understanding of how alternative data bases can be applied to the different orders. This understanding is directly related to one's ability to justify and/or defend use of the selected allocation procedure. Figure 3.1-1 diagrams the sequence in which the various tables will be used in each allocation order. Some tables are used in more than one order. Table 3.1-1 is used to develop population-based allocation proportions for an Order 1 calculation. Similarly, Table 3.1-2 is employed in Orders 2 and 3 to determine the distribution of dwelling units among subcounty areas designated by the user. Tables 3.1-3 through 3.1-6 are used, respectively, to establish the distribution of dwelling unit building sizes and fuel use among the various subcounty areas. Tables 3.1-5 and 3.1-6 are used to determine annual fuel use by dwelling unit building size, based on the degree days for the region under study. Tables 3.1-7 through 3.1-9 are used in arriving at final emission Levels; therefore, they are employed in all three Orders. Table 3.1-7 is used to allocate annual fuel use by fuel type to the specified subcounty areas. Table 3.1-8 provides a format for summarizing emission factors published in the Compilation of Air Pollutant Emission Factors (AP-42). Finally, pollutant specific emissions resulting from residential space heating are allocated to the various subcounty areas and recorded in Table 3.1-9.

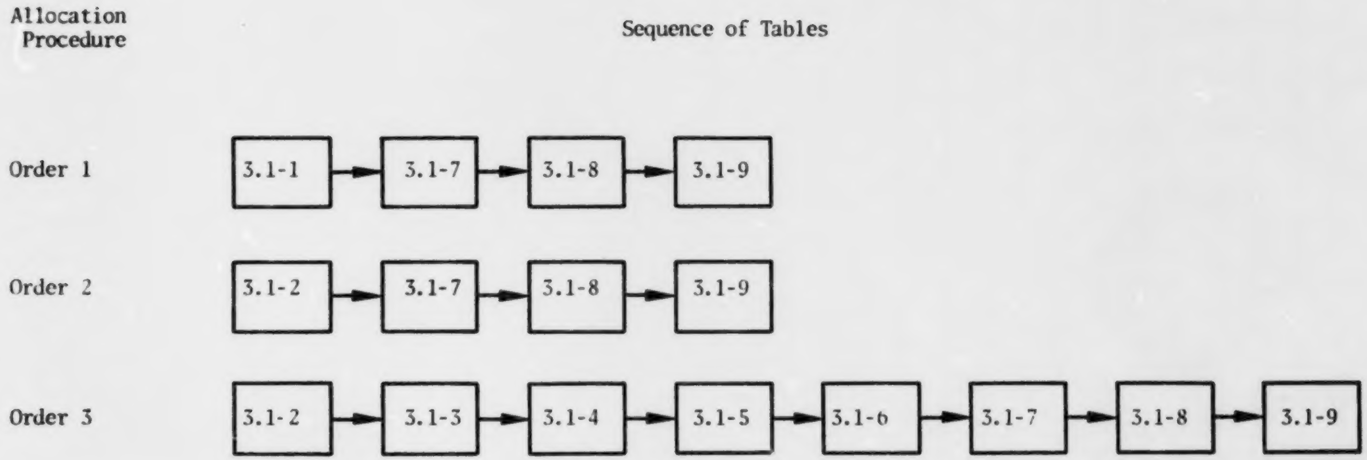
Allocation Procedure
Sequence of Tables
Order 1
3.1-1
3.1-7
3.1-8
3.1-9
Order 2
3.1-2
3.1-7
3.1-8
3.1-9
Order 3
3.1-2
3.1-3
3.1-4
3.1-5
3.1-6
3.1-7
3.1-8
3.1-9

Figure 3.1-1 Residential Fuel Combustion Allocation Table Sequence

Table 3.1-1

Population-Based Allocation Proportions for Subcounty Areas

A. County ________________
B. Year ________________
C. Allocation Order __1__

(1) Subareas	(2) Population	(3) Allocation Proportion
SUBAREA TOTAL		
Residual[1]		
D. COUNTY TOTAL		1.0

[1] Residual is equal to the COUNTY TOTAL (row D, column [2]) minus the sum of the population accounted for by all specified subcounty areas.

$$RP = TPOP - \sum_{i=1}^{N} POP_i$$

where:
RP = Residual population not accounted for by specified subareas
TPOP = COUNTY TOTAL (row D, column [2])
POP_i = Population in each specified subcounty area i.

Table 3.1-2

Dwelling-Unit-Based Allocation Proportions for Subcounty Areas

A. County ________________
B. Year ________________
C. Allocation Order 2 and 3

	(1) Subarea	(2) Number of Dwelling Units	(3) Allocation Proportion
	SUBAREA TOTAL		
	Residual [1]		
D.	COUNTY TOTAL		1.0

---

[1] Residual is equal to the COUNTY TOTAL (row D, column [2]) minus the sum of the dwelling units accounted for by all specified subcounty areas.

$$RDU = TDU - \sum_{i=1}^{N} DU_i$$

where:

RDU = Residual dwelling units not accounted for by specified subareas
TDU = COUNTY TOTAL (row D, column 2)
DU_i = Dwelling units in each specified subcounty area i

Table 3.1-3

Residential Building Size Distribution

A. County ______________
B. Year ______________
C. Allocation Order __3__

	Dwelling Units by Building Size [1]												Total Dwelling Units
(1)	(2)		(3)		(4)		(5)		(6)		(7)		(8)
Subarea	Number	Proportion	Number	Proportion	Number	Proportion	Number	Proportion	Number	Proportion	Number	Proportion	
SUBAREA TOTAL													
Residual													
D. COUNTY TOTAL													

---

[1] Building size categories are arbitrary. User must specify intervals for number of dwelling units per building based on considerations of data availability, level of detail desired and time required for computation.

Table 3.1-4

Residential Fuel Use Distribution

A. County ______
B. Year ______
C. Allocation Order ______

(1) Subarea	Dwelling Units by Fuel Use																Total Dwelling Units (10)
	Coal						Oil				Natural Gas		Electricity		Other		
	(2) Anthracite		(3) Bituminous		(4) Lignite		(5) Distillate		(6) Residual		(7)		(8)		(9)		
	Number	Proportion	Number	Proportion	Number	Proportion	Number	Proportion	Number	Proportion	Number	Proportion	Number	Proportion	Number	Proportion	
SUBAREA TOTAL																	
Residual																	
% COUNTY TOTAL																	

Table 3.1-5

Residential Fuel Use Factors by Building Size

A. County ________________
B. Year ________________
C. Allocation Order ___3___

	Fuel Use Factors					
	Coal (lbs/degree-day)			Oil (gals/degree-day)		Natural Gas (ft^3/degree-day)
(1) Number of Dwelling Units per Building[1]	(2) Anthracite	(3) Bituminous	(4) Lignite	(5) Distillate	(6) Residual	(7)

---

[1] User must specify building size categories in accordance with those specified in Table 3.1-3.

Table 3.1-6

Annual Residential Fuel Use by Building Size

A. County ____________
B. Year ____________
C. Allocation Order 3

	Annual Fuel Use					
	Coal (tons/yr)			Oil (10^3 gal/yr)		Natural Gas (10^6 ft^3/yr)
(1) Number of Dwelling Units Per Building [1]	(2) Anthracite	(3) Bituminous	(4) Lignite	(5) Distillate	(6) Residual	(7)

---

[1] User must specify building size categories in accordance with those specified in Table 3.1-3.

Table 3.1-7

Residential Fuel Use Allocated to Subcounty Areas

A. County ______________

B. Year ______________

C. Allocation Order 1, 2, and 3

(1) Subarea	Annual Fuel Use					
	Coal (tons/yr)			Oil (10^3 gal/yr)		Natural Gas (10^6 ft^3/yr)
	(2) Anthrocite	(3) Bituminous	(4) Lignite	(5) Distillate	(6) Residual	(7)
SUBAREA TOTAL						
Residual						
D. ACTUAL COUNTY TOTAL						
E. COMPUTED COUNTY TOTAL[1]						

---

[1] This row will be used only in cases where an Order 3 allocation procedure is being followed.

Table 3.1-8
Residential Fuel Combustion Emissions Factors

A. County ____________________
B. Year ____________________
C. Allocation orders 1, 2 and 3

	(1)	Emission Factors				
		(2) Part.	(3) SO_x	(4) CO	(5) HC	(6) NO_x
Coal	Anthracite					
	Bituminous					
	Lignite					
Oil	Distillate					
	Residual					
Natural Gas						

Table 3.1-9

Residential Fuel Combustion Emissions Allocated to Subcounty Areas

A. County ____________

B. Year ____________

C. Allocation Order 1, 2 and 3

	Emissions (tons/yr)				
(1) Subarea	(2) Part.	(3) SO_x	(4) CO	(5) HC	(6) NO_x
SUBAREA TOTAL					
Residual					
D. COUNTY TOTAL					

3.1.4 Order 1 Allocations

As the least extensive method for distributing residential emissions, Order 1 requires only two types of data: (1) total county population and the population residing in each specified subcounty area and (2) the total amount of residential space heating fuel used in the county. These data are recorded in Tables 3.1-1 and 3.1-7 and fuel combustion emissions are computed for each subcounty area, using Tables 3.1-8 and 3.1-9.

Population-Based Allocation Proportions: Table 3.1-1

1. Fill in the descriptive information at the top of the table (items A through C).
2. Enter the county's total resident population (actual for past or present year(s) and projected for future years) in column (2) of row D (COUNTY TOTAL).
3. List all subcounty areas (municipalities, townships, grid cells, etc.) in column (1).
4. Enter population (actual for past or present year(s) and projected for future years) for each subcounty area in column (2).
5. Total the population over all subcounty areas and record this sum in column (2) of the SUBAREA TOTAL row.
6. The population residing in the county, but not living in any specified subareas, is the residual population. To arrive at this number, SUBAREA TOTAL, (row D, column (2)) and the difference is entered in column (2) of the Residual row.
7. Allocation proportions for each subcounty area can now be computed. Taking each subarea separately, the population figure (column (2)) is divided by the COUNTY TOTAL (row D, column (2)). This proportion is computed for each subcounty area as well as the Residual, and entered in column (3).

Residential Fuel Use: Table 3.1-7

1. Fill in the descriptive information at the top of the table (items A through C).
2. Enter the total amount of each type of fuel used for residential space heating in the county in row D (ACTUAL COUNTY TOTAL) columns (2) through (7). This information is obtained from the countywide analysis carried out as per the instructions detailed in Projecting County Emissions: Volume 7 of the Guidelines. (See note following.)

NOTE: Where it is impossible to obtain coal and/or oil use broken down by type, enter total amounts (regardless of type) in the most likely column (e.g., columns (2)-(4) of coal; columns (5) or (6) for oil).

3. List all subcounty areas in column (1), using the same designations and following the same sequence employed in Table 3.1-1.

4. Handling each subarea separately, residential fuel consumption by fuel type is next allocated to all subareas and the Residual, using the allocation proportions in Table 3.1-1. This is accomplished by multiplying the total amounts of fuel (by type) used in the county (row D, columns (2) through (7), Table 3.1-7) by the subarea specific allocation proportion in column (3) of Table 3.1-1. The resulting amounts to be entered in columns (2) through (7) of Table 3.1-7 are estimates for the different types of fuel consumed in each subarea of the county.

NOTE: The SUBAREA TOTAL row is provided as a check on previous work; it will not be used in the final computation of residential fuel combustion emissions.

Residential Fuel Combustion Emission Factors: Table 3.1-8

1. Examine this table, column (1) specifies fuel type which is compatible with the breakdown in Table 3.1-7 and columns (2) through (6) indicate the five pollutants for which emissions will be allocated to various subareas of the county.

2. For each type of fuel; locate the appropriate emission factor from the Compilation of Air Pollutant Emission Factors (AP-42). Enter this value along with the unit in which emissions will be computed in the appropriate cell of Table 3.1-8. The user is cautioned to check that the latest edition or supplement to AP-42 is being used as this document is constantly being updated.

NOTE: Technically, National Ambient Air Quality Standards (NAAQS) are written for sulfur oxides (SO_x) and for nitrogen dioxide (NO_2) rather than nitrogen oxides (NO_x). However, the EPA has consistently assumed that NO is essentially reduced to NO_2 very rapidly and all emission factors are given for NO_x. To maintain consistency in allocating emissions to subcounty areas, all of the tables used to record emission factors from AP-42 utilize a pollutant designation for NO_x rather than NO_2.

Allocated Residential Fuel Combustion Emissions: Table 3.1-9

1. Fill in the descriptive information at the top of the table (items A through C).
2. List all subareas in column (1) using the same designations and following the same sequence employed in Tables 3.1-1 and 3.1-7.
3. Handling each subarea sequentially, compute total emissions for each pollutant using the following steps:
    a. For each type of fuel, multiply the pollutant specific emission factor in Table 3.1-8 by the annual fuel consumption in Table 3.1-7.
    b. On a separate sheet of paper (or storage register of a calculator), keep a running total of emissions for the first pollutant (e.g., particulates) for the subarea in question. After summing these particulate emissions over all types of fuel used, enter the number for the subarea in Table 3.1-9.
    c. Continuing with the same subarea, go on to calculate and enter total emission levels for sulfur oxides, carbon monoxide, etc., repeating steps 3a and 3b until all pollutants are completed.
    d. Go to the next subcounty area and repeat steps 3a through 3c. Continue until emissions have been calculated for all subareas, the SUBAREA TOTAL, the Residual, and the COUNTY TOTAL.

3.1.5 Order 2 Allocations

As the intermediate procedure for allocating residential emissions to subcounty areas, the second Order method requires two types of data: (1) the number of dwelling units in each specified subcounty area and (2) the total amount of residential space heating fuel used in the county. These data are recorded in Tables 3.1-2 and 3.1-7, and fuel combustion emissions are computed for the various subcounty areas, using Tables 3.1-8 and 3.1-9. This differs from Order 1 allocations in that the distribution is made on the basis of dwelling units rather than population.

Dwelling-Unit-Based Allocation Proportions: Table 3.1-2

1. Fill in the descriptive information at the top of the table (items A through C).

2. Enter the total number of dwelling units (actual for past or present years or projected for future years) located in the county in column (2), row D (COUNTY TOTAL).

3. List all subcounty areas (municipalities, townships, grid cells, etc.) in column (1).

4. Enter the number of dwelling units (actual for past or present year(s) and projected for future years) for each subarea in column (2).

5. Total the number of dwelling units over all subcounty areas and record this sum in column (2) of the SUBAREA TOTAL row.

6. The total number of dwelling units that are located in the county but not in any of the specified subareas is the Residual. To obtain this number, the TOTAL dwelling units derived in step 5 is subtracted from the COUNTY TOTAL (row D, column (2)). This difference is entered in column (2) of the Residual row.

7. Allocation proportions for each subarea of the county can now be computed. Taking each subarea separately, the number of dwelling units (column (2)), is divided by the COUNTY TOTAL (row D, column (2)). This proportion is computed for each subarea as well as the Residual and entered in column (3) of the appropriate row.

Residual Fuel Use Allocated to Subcounty Areas: Table 3.1-7

1. Fill in the Table as indicated in steps 1-4 under the Order 1 allocation procedure.

2. When proceeding to step 4, use the allocation proportion in column (3) of Table 3.1-2 instead of Table 3.1-1.

Residual Fuel Combustion Emission Factors: Table 3.1-8

1. Fill in as described in Order 1 procedures.

Allocated Residential Fuel Combustion Emissions: Table 3.1-9

1. Fill in as described in Order 1 procedures.

3.1.6 Order 3 Allocations

Order 3 provides the most extensive procedure for allocating emissions resulting from residential space heating. It requires three pieces of information for each subcounty area: (1) the number of dwelling units, (2) the residential building size distribution, and (3) the residential fuel use distribution. These data are recorded in Tables 3.1-2, 3.1-3, and 3.1-4 and used to compute residential fuel combustion emissions in each subcounty area, using Tables 3.1-5 through 3.1-9. This procedure differs from the two previous Orders in that the subarea fuel use is computed directly and compared to the county total for consistency. The county total is used as a mass balance check only.

Number of Dwelling Units in Each Subcounty Area: Table 3.1-2

1. Fill in as described in steps 1-5 under Order 2 procedures.
2. It is not necessary to fill in column (3).

Residential Building Size Distributions: Table 3.1-3

1. Fill in the descriptive information at the top of the table (items A through C).
2. Specify building size categories along the top row of the table. The columns of this row are purposely left blank so that the user can employ the best building size data at his disposal.

   NOTE: In many cases it will be impossible to fill in all of the columns provided because the user will not have detailed building size data disaggregated to as many as six categories. For example, in using data from the U.S. Census of Housing, computations will be restricted to four dwelling-units-per-building categories: 1, 2 to 4, 5 to 9, and 10 or more.

3. Enter the total number of occupied dwelling units in each building size category for the county in the appropriate columns of Row D, COUNTY TOTAL.
4. List all subcounty areas (municipalities, townships, grid cells, etc.) in column (1) using the same designations and following the same sequence used in Table 3.1-2.
5. In the left column of the various building size categories, record the number of dwelling units in that category for each subarea.
6. For each subarea, tabulate the total number of dwelling units in column (8). These data should correspond to the column (2) entry from Table 3.1-2.
7. For each building size column, sum the number of dwelling units over all subareas and record each total in the appropriate column of the TOTAL row.

8. The number of dwelling units in each size category that are located in the county but not in any of the specified subareas is the Residual. To obtain this number for each building size category, the sums obtained in step 7 are subtracted from the COUNTY TOTAL (Row D). This difference is entered in the appropriate Number columns of the Residual row.

9. Distribution functions for each subcounty area and the Residual of the county can now be computed for each of the building size categories. Handling each subarea separately, the number of dwelling units in each size category is divided by the total number of dwelling units in the subarea (column (8)). This value is recorded in the Proportion column. Note that the normalizing total is the total dwelling units in the subarea and not the county total.

Residential Fuel Use Distributions: Table 3.1-4

1. Fill in the descriptive information at the top of the table (items A through C).

2. Enter the total number of occupied dwelling units in the county heated with the different types of fuel in the appropriate columns of row D (COUNTY TOTAL).

3. List all subcounty areas (municipalities, townships, grid cells, etc.) using the same designations and following the same sequence employed in Tables 3.1-2 and 3.1-3.

4. In the left column for the various kinds of fuel, record the Number of dwelling units using that fuel for each subcounty area.

   NOTE: In many cases it will be impossible to obtain a number for each kind of fuel broken down by type. For example, in using data from the U.S. Census of Housing, coal use is not disaggregated into anthracite, bituminous and lignite. Similarly, oil heating is not broken down into subcategories for distillate and residual. Where sub-classification cannot be accomplished, it will be necessary to enter all dwelling units heated with coal and/or oil under the most predominantly used subtype.

5. For each subarea tabulate the total number of dwelling units in column (10). These data should correspond to column (2) in Table 3.1-2.

6. For each fuel column, sum the dwelling units over all subareas and record each total in the appropriate column of the SUBAREA TOTAL row.

7. The number of dwelling units heated with the different kinds of fuel that are located in the county but are not in any of the specified subareas is the Residual. To obtain this number for each fuel use category, the sums obtained in step 6 are subtracted from the COUNTY TOTAL (row D). This difference is entered in the appropriate Number column of the Residual row.

8. Distribution functions for each subcounty area and the Residual of the county can now be computed for each kind of fuel used in residential space heating. Handling each subarea separately, the number of dwelling units in each fuel category is divided by the total number of dwelling units in the subarea (column (10)). This value is recorded in the Proportion column. As with the building size distribution, the normalizing total is the total dwelling units in the subarea and not the county total.

Residential Fuel Use Factors by Building Size: Table 3.1-5

Table 3.1-5 is used to tabulate the amount of different kinds of fuel used to heat residential buildings of different sizes under specified climatic conditions. Since these climatic conditions can be assumed to be constant over large areas, Table 3.1-5 will be filled in only once for the entire county and these heating requirement factors will be uniformly applied to all subareas within the county.

Lacking any more specific information the following data can be employed in generating the fuel use factors to be entered in Table 3.1-5:

1. The average heating requirement (HR) for a single-family dwelling unit is 17,000 Btu per degree-day.

   NOTE: One degree-day is defined for each degree the daily average temperature drops below 65°F. For example, a daily average temperature of 60° yields 5 degree-days. The degree-days for various parts of the country are published in the Climatic Atlas of the United States.

2. Each type of fuel has the following heating values (HV):

coal	11,000 Btu/lb
oil	144,000 Btu/gal
natural gas	800 Btu/ft^3

3. Heating plants designed to burn different types of fuels are assigned the following efficiencies (HPE), taken from The Time-Saver Standards

coal	65%
oil	75%
natural gas	80%

4. Normalized to an average single-family dwelling unit, the relative fuel requirements for multi-unit buildings are assumed to decrease as follows:

Relative Fuel Requirements (RFR) by Fuel Type

Number of Dwelling Units per Building	Type of Fuel Coal	Oil	Natural Gas
1	1.0	1.0	1.0
2 - 4	.90	.90	.90
5 - 9	.78	.78	.74
10 -19	.68	.68	.64
20 -49	.57	.57	.49
50 >	.51	.51	.44

The above fuel requirements were developed from data provided by the Chicago Department of Environmental Control.

Employing these assumptions, the total annual fuel requirements are computed for each building size category by calculating a fuel use factor. This factor is computed for each fuel for each building size using the following formula:

$$FUF_{ij} = \frac{HR \times RFR_{ij}}{HV_i \times HPE_i}$$

where:

FUF_{ij} = fuel use factor for fuel i, building size j

HR = average heating requirement for a single-family dwelling unit (see 1 above)

RFR_{ij} = relative fuel requirement for fuel i, building size j (see 4 above)

HV_i = heating value (Btu/quantity of fuel) for fuel i (see 2 above)

HPE_i = heating plant efficiency for fuel (see 3 above)

If the above assumptions are used then the following values should be entered in Table 3.1-5. If more region-specific data are available, then Table 3.1-5 can be completed with that information using the above calculation procedure.

Fuel Use Factors (FUF)

Number of Dwelling Units per Building	Coal (lbs/degree-day)	Oil (gals/degree-day)	Natural Gas (ft^3/degree-day)
1	2.38	.157	26.6
2 - 4	2.14	.142	23.9
5 - 9	1.85	.123	19.7
10 - 19	1.62	.107	17.0
20 - 49	1.36	.090	13.0
50 +	1.21	.080	11.7

Annual Residential Fuel Use by Building Size: Table 3.1-6

The annual fuel requirements for each type of fuel for each building size category can now be computed for the region under study using the formula:

$$AFR_{ij} = FUF_{ij} \times DD$$

where:

AFR_{ij} = Annual requirement of fuel i used to heat dwelling units in building size category j.

DD = Annual degree days for region (see 1. above)

1. Fill in the descriptive information at the top of the table (items A through C).
2. Each fuel use factor (FUF_{ij}) developed in Table 3.1-5 is multiplied by the annual degree days (DD) for the region and the result (AFR_{ij}) is entered in the appropriate cell of Table 3.1-6.

NOTE: Table 3.1-6 like Table 3.1-5 will be filled out only once for the county being analyzed.

Residential Fuel Use Allocated to Subcounty Areas: Table 3.1-7

1. Fill in the descriptive information at the top of the table (items A through C).

2. Enter the total amount of each kind of fuel used to heat all dwelling units in the county in row D, (ACTUAL COUNTY TOTAL) columns (2) through (7).

   NOTE: Where it is impossible to obtain coal and/or oil use broken down by type, enter total amounts (regardless of type) in the most likely columns (e.g., columns (2)-(4) for coal; (5) or (6) for oil).

3. List all subcounty areas in column (1) using the same designations and following the same sequence employed in previous tables.

4. Handling each subcounty area separately, residential fuel combustion by fuel type is computed for all subareas and the Residual, using data assembled in Tables 3.1-2 through 3.1-6.

   a. Beginning with the first building size category in Table 3.1-3 (column (2)), multiply the number of units in each building size category (Number entry in columns (2) through (7) of Table 3.1-3) by the Proportion of dwelling units heated with the first type of fuel recorded in Table 3.1-4 (e.g., anthracite coal).

   b. Multiply the result obtained in step 4a by the appropriate annual fuel requirement in Table 3.1-6 (e.g., anthracite coal). Store this result on a separate sheet of paper or in a storage register of an electronic calculator.

   c. Repeat steps 4a and 4b for all building size categories. Enter the total for all categories into the appropriate column of Table 3.1-7.

   d. Repeat steps 4a-4c for all fuel types and subareas until all the cells of Table 3.1-7 are filled in. Note that it is not necessary to carry along the dwelling units using electricity or other fuels.

5. For each type of fuel, sum the amounts used over all subareas and the Residual. Enter each total in the appropriate column of row E (COMPUTED COUNTY TOTAL).

6. Each of the fuel specific COMPUTED COUNTY TOTAL calculated from each, step 5, should approximate the fuel specific values entered in row D (ACTUAL COUNTY TOTAL). If the values for any type of fuel in rows D and E differ significantly, then the fuel use requirement on Table 3.1-6 needs to be adjusted. This can be effectively achieved without repeating the calculations by scaling all of the subarea fuel use computations in Table 3.1-7 by the ratio of the row D to row E values.

Residential Fuel Combustion Emission Factors: Table 3.1-8

1. Fill in as described in Order 1 procedures.

Allocated Residential Fuel Combustion Emissions: Table 3.1-9

1. Fill in as described in Order 1 procedures.

3.2 TRANSPORTATION

3.2.1 Introduction

Transportation systems represent another widely present source of air pollutant emissions. Though tied very closely to residential population distribution, there are some characteristics of the transportation network that cannot be described by a population-based distribution function. Also, in many areas the transportation planning group is not the same as the regional planning commission. In ideal situations the two would be in close communication and would use mutually compatible data bases, but this is not always the case. Some of the differences in information presentation formats have already been described in Section 2.

The transportation emission sources dealt with in this section are motor vehicles, airports, railroad engines, sea and river vessels, and miscellaneous sources (e.g., farm tractors, construction equipment, etc.) For motor vehicles, procedures for three Orders of detail will be outlined. For all other sources, which in total represent only a small fraction of the transportation-generated emissions, only one Order will be proposed and this is described under the general Order 3 procedures.

3.2.2 Data Requirements

Each of the 3 Orders of analysis require successively more detailed information. The following is a list of data requirements and potential sources for the data for each Order.

All Orders:

a. Motor vehicle emission factors incorporating the effects of county vehicle age distribution and vehicle use. (Source: analysis carried out per Projecting County Emissions: Volume 7 of the Guidelines. If county specific data are not available, then national average data from AP-42 should be used.)

b. Location and traffic volume counts for all limited access highways (interstates, major state and county highways, etc.) both existing and projected. (Sources: state highway department or U.S. Department of Transportation published data.)

c. Countywide totals (actual for base years, projected for forecast years) of vehicle-miles-traveled (VMT) for three classes of vehicle: light duty gasoline-powered vehicles (LDG), heavy duty gasoline-powered vehicles (HDG), and heavy duty diesel-powered vehicles (HDD). (Source: Analysis carried out per Projecting County Emissions: Volume 7 of the Guidelines.) Although there are five vehicle classes treated in this document the output can be easily modified to three vehicle classes for these subcounty allocation procedures.)

Order 1:

a. Actual and projected population for each specified area. (Sources: U.S. Census of Population; state, regional and local planning agencies.

b. Countywide motor vehicle VMT for base and forecast years for three vehicle classes: LDG, HDG, HDD. (Source: Projecting County Emissions: Volume 7 of the Guidelines.)

Order 2:

a. Motor vehicle VMT for three vehicle classes for each specified subcounty area for base and forecast years. (Source: local transportation planning group, state or local highway department, or regional planning commission.) Note that it is not necessary for these subcounty areas to correspond to the population-based subcounty areas.

b. Motor vehicle average speeds for each specified subcounty area. (Source: same as for (a) above.)

Order 3:

a. Motor vehicle VMT for three vehicle classes and average motor vehicle speeds for base and forecast years on a highly resolved subcounty area network. Computer facilities will be required to handle these data. (Source: same as for a and b of Order 2.)

b. Location and activity data for all major airports, railroad terminals, port facilities, and concentrations of miscellaneous sources both existing and projected. (Source: regional planning agencies, maps, regional transportation groups.)

3.2.3 Procedural Overview

Figure 3.2-1 diagrams the sequence of table use for allocating transportation emissions. All three orders of analysis involving motor vehicles rely on the initial separation of limited access highways. These roads are unique in their location and traffic characteristics and therefore cannot be

Sequence of Tables

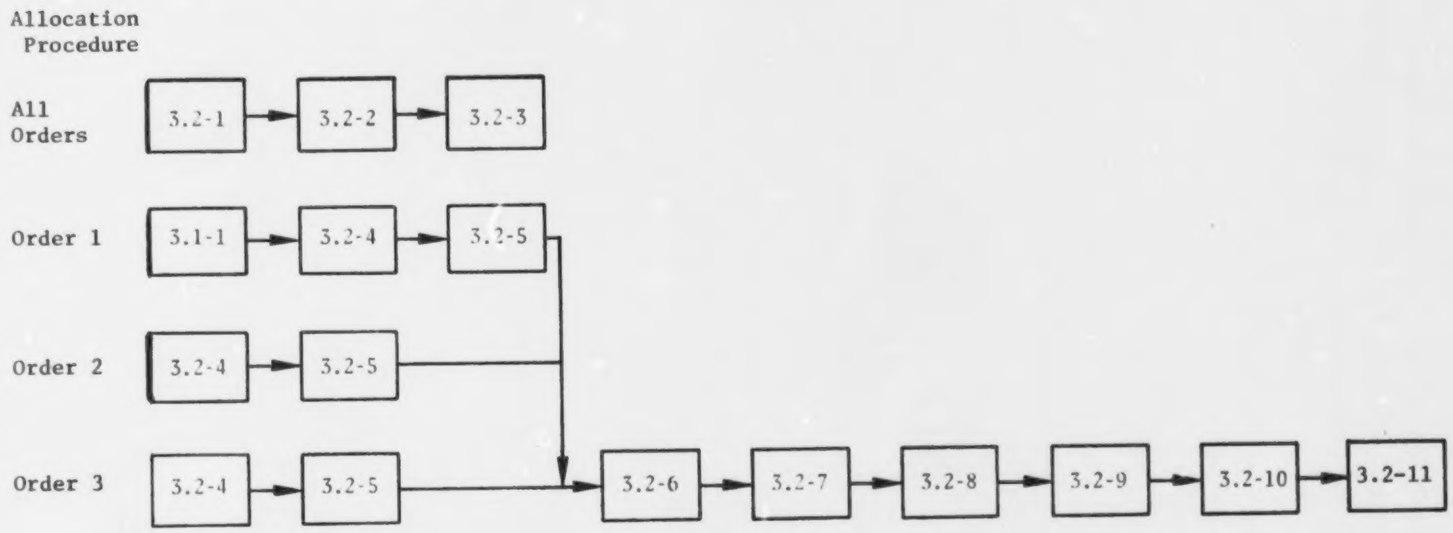
Allocation Procedure
All Orders
Order 1
Order 2
Order 3
3.2-1
3.2-2
3.2-3
3.1-1
3.2-4
3.2-5
3.2-4
3.2-5
3.2-4
3.2-5
3.2-6
3.2-7
3.2-8
3.2-9
3.2-10
3.2-11

Figure 3.2-1 Transportation Allocation Table Sequence distributed to subcounty areas by any of the traditional demographic variables. This is true for both existing and projected highways. Once these roads are identified and separated out, the remaining motor-vehicle activity can be allocated by one of the three analysis Orders.

Order 1 procedures rely on the distribution of the remaining vehicle-miles using the population distribution functions developed in Section 3.1. Order 2 procedures depend on the use of a transportation planning grid developed by a local agency on which VMT are projected. This grid may or may not correspond to the population grids used previously. Order 3 is essentially the same as Order 2, with the exception that it is assumed that an extensive transportation simulation model is available and computer capability exists to make use of the output from the model.

For non-motor vehicle emission sources the single allocation procedure relies on the identification of the location of the specific sources. These sources are not, in general, widespread throughout the county and can be isolated in specific subcounty areas.

Choice of allocation Order is governed primarily by the availability of data but may be modified by the need for more or less refinement. If countywide VMT were estimated on the basis of automotive fuel sales (Level 1 analysis, Projecting County Emissions: Volume 7), then it is assumed that more detailed data are not available or cannot be assessed with available resources. Hence, Order 1 subcounty allocation procedures are the only ones relevant. If countywide VMT were obtained from a transportation planning group (Level 2 analysis, Projecting County Emissions: Volume 7) and no subcounty breakdown was available, then Order 1 procedures are still the only ones meaningful. If the countywide VMT were determined by aggregating subcounty estimates (Level 2 and/or 3, Projecting County Emissions: Volume 7), then the data are already available for Order 2 or 3 allocation procedures.

Table 3.2-1

Motor Vehicle Emission Factors

A. County ____________________
B. Year ______________________
C. Allocation Order 1, 2 and 3

	Emission Factors (grams/vehicle-mile)					
(1) Vehicle Class	(2) Part.	(3) SO_x	(4) CO	(5) HC (exhaust)	(6) HC (evap.)	(7) NO_x
LDG						
HDG						
HDD						

Table 3.2-2

Limited Access Highway Data

A. County ____________

B. Year ____________

C. Allocation Order 1, 2, and 3

Identification Number (1)	Highway Segment				Length (mi) (4)	Annual Volume (10^6 vehicles/yr)			VMT (10^6 vehicle-miles/yr)			Speed[1] (mph) (11)
	(2) Begin		(3) End			(5) LDG	(6) HDG	(7) HDD	(8) HDG	(9) HDG	(10) HDD	
	x	y	x	y								
D. COUNTY TOTAL												

If available.

Table 3.2-3

Limited Access Highway Emissions

A. County ______________

B. Year ______________

C. Allocation Order 1, 2, and 3

	Emissions (10^3 tons/yr)																		
Highway Segment Sequence Identification (1)	Part.			SO_x			Speed Correction Factor CO (8)	CO			Speed Correction Factor HC (12)	HC(exhaust)			H.(evap.) (16)	Speed Correction Factor NO_x (17)	NO_x		
	(2) LDG	(3) HDG	(4) HDD	(5) LDG	(6) HDG	(7) HDD		(9) LDG	(10) HDG	(11) HDD		(13) LDG	(14) HDG	(15) HDD			(18) LDG	(19) HDG	(20) HDD
D. COUNTY TOTAL																			

Table 3.2-4

Motor Vehicle Data Allocated to Subcounty Areas

A. County ____________________
B. Year ______________________
C. Allocation Order 1, 2, and 3

Subarea (1)	VMT (10^6 Vehicle-miles/yr)			Average Speed (mph) (5)
	(2) LDG	(3) HDG	(4) HDD	
SUBAREA TOTAL				
Residual				
D. COUNTY TOTAL				

Table 3.2-5

Motor Vehicle Emissions Allocated to Subcounty Areas

A. County ____________

B. Year ____________

C. Allocation Order 1, 2, and 3

Subarea	Emissions (10^6 tons/yr)																		
	Part.			SO_x			Speed Correction Factor CO	CO			Speed Correction Factor HC	HC(exhaust)			HC(evap.)	Speed Correction Factor NO_x	NO_x		
(1)	(2) LDG	(3) HDG	(4) HDD	(5) LDG	(6) HDG	(7) HDD	(8)	(9) LDG	(10) HDG	(11) HDD	(12)	(13) LDG	(14) HDG	(15) HDD	(16)	(17)	(18) LDG	(19) HDG	(20) HDD
SUBAREA TOTAL																			
Residual																			
D. COUNTY TOTAL																			

Table 3.2-6

Airport Emissions

A. County ________________
B. Year ________________
C. Allocation Order 3

Name of Airport (1)	Square Coordinates (2)		Square Length (3)	Activity Proportion (4)	Emissions (10⁶ tons/yr)				
					(5) Part.	(6) SO_x	(7) CO	(8) HC	(9) NO_x
	x	y							
D. COUNTY TOTAL				1.0					

Table 3.2-7

Railroad Emissions-Track

A. County ______________
B. Year ______________
C. Allocation Order 3

Subareas Containing Track (1)	Activity Proportion (2)	Emissions (10^6 tons/yr)				
		(3) Part.	(4) SO_x	(5) CO	(6) HC	(7) NO_x
D. COUNTY TOTAL	1.0					

Table 3.2-8

Railroad Emissions-Yards

A. County ________________
B. Year ________________
C. Allocation Order 3

Yard Designation (1)	Square Coordinates (2)		Square Length (3)	Activity Proportion (4)	Emissions (10^6 tons/yr)				
	x	y			(5) Part.	(6) SO_x	(7) CO	(8) HC	(9) NO_x
D. COUNTY TOTAL				1.0					

Table 3.2-9
Sea Vessel Emissions

A. County ____________
B. Year ____________
C. Allocation Order 3

Subarea (1)	Activity Proportion (2)	Emissions (10^6 tons/yr)				
		(3) Part.	(4) SO_x	(5) CO	(6) HC	(7) NO_x
SUBAREA TOTAL						
Residual						
D. COUNTY TOTAL	1.0					

Table 3.2-10
Off-highway Vehicle Emissions

A. County _______________
B. Year ________________
C. Allocation Order 3

Subarea (1)	Activity Proportion (2)	Emissions (10^6 tons/yr)				
		(3) Part.	(4) SO_x	(5) CO	(6) HC	(7) NO_x
SUBAREA TOTAL						
Residual						
D. COUNTY TOTAL	1.0					

Table 3.2-11

Transportation Emissions Allocated to Subcounty Areas

A. County ____________________
B. Year ____________________
C. Allocation Order 1, 2 and 3

(1) Subarea	Emissions (tons/yr)				
	(2) Part.	(3) SO_x	(4) CO	(5) HC	(6) NO_x
SUBAREA TOTAL					
Residual					
D. COUNTY TOTAL					

3.2.4 Motor Vehicle Emission Factors

Emission factors for motor vehicles are county-specific in that they rely on the county vehicle age distribution and vehicle use patterns. Details on how to develop these factors are given in AP-42. One note of caution needs to be expressed. Projecting County Emissions: Volume 7 of the Guidelines indicates that county vehicle age distributions are usually not available, and it can therefore be assumed that all vehicles after the 1976 model year will meet 1976 emission standards and that this emission rate can be used for 1980 and later emission factors. This assumption can lead to serious under-predictions of vehicle emissions; an error on the order of a factor of 10-20 in CO emissions, for example, is not unusual. If county vehicle age data is not available, it is recommended that national average data, which is readily available in AP-42, may be used instead.

Motor Vehicle Emission Factors: Table 3.2-1

1. Fill in the descriptive information at the top of the table (items A through C).
2. Using the Compilation of Air Pollutant Emission Factors (AP-42), fill in the emission factors for each vehicle class for each pollutant. The user is cautioned to check that the latest edition or supplement of AP-42 is being used as this document is constantly being updated.
3. Repeat steps 1 and 2 for each projection year and for each county.

3.2.5 Limited Access Highways

The network of limited access highways, both existing and projected, should be determined from a regional road map obtained from the state highway department or from U.S. Geological Survey (USGS) maps. The Highway Capacity Manual may help in defining which highway segments are to be included. The maps to be used should have indicated on them a geographic reference system, preferably keyed to the Universal Transverse Mercator (UTM) coordinate grid system since this is available everywhere in the U.S. (UTM coordinate marks are given on all USGS maps.)

The defined limited access highway network should next be subdivided into approximately straight line segments or links and vehicle-miles-traveled or vehicle count data assembled for each segment. These data are available from the state highway department, regional 3-C planning agencies, or from the Federal Highway Administration. VMT-link-type data for most 3-C planning areas are available with 1968 base years projected to 1990 or 2000.

Limited Access Highway Data: Table 3.2-2

1. Fill in the descriptive information at the top of the table (items A through C).

2. Enter the segment identification number and x, y coordinates for each of the straight line segments determined above in columns (1), (2) and (3).

3. Compute and enter the length of each segment in column (4).

4. Enter the annual volume by vehicle type in columns (5), (6) and (7). If actual vehicle type distributions are unknown, use the countywide distribution determined in the analysis per Projecting County Emissions: Volume 7 of the Guidelines.

5. Multiply the volumes in columns (5), (6), and (7) by the segment length in column (4) and enter the resulting products into columns (8), (9), and (10), respectively.

6. Sum columns (4)-(10) and enter into the respective columns of the COUNTY TOTAL row (row D), at the bottom of the table.

Limited Access Highway Emissions: Table 3.2-3

1. Fill in the descriptive information at the top of the table (items A through C).

2. In column (1) enter the segment sequence identification number from column (1) of Table 3.2-2.

3. For each segment determine the speed correction factors for CO, exhaust HC, and NO_x using the speed in column (11) of Table 3.2-2 and the correction curves from AP-42. Enter these into columns (8), (12), and (17), respectively.

4. Starting with the first segment, multiply the VMT for each vehicle type by the emission factor for each pollutant. For particulates and SO_x, enter these results into columns (2)-(4) and (5)-(7), respectively. For CO, exhaust HC and NO_x, multiply the result of the VMT-emission-factor multiplication by the appropriate speed correction factors, found in column (8), (12), or (17). Enter these results in columns (9)-(11), (13)-(15), (18)-(20), respectively.

5. Note that the evaporative hydrocarbons emission rates are applicable only to gasoline-powered vehicles. There are factors for each type; multiply the emission factors from Table 3.2-1 and the VMT for light and heavy duty vehicles. Add these products together and enter the sum in column (16).

6. Repeat steps 4 and 5 for each road segment.

7. Sum columns (3)-(7), (9)-(11), (13)-(16) and (18)-(20). Enter the results in the COUNTY TOTAL row (row D) at the bottom of the table.

3.2.6 Order 1 Allocations

This allocation Order is used when it is determined that there are no subcounty data available for motor vehicle VMT or when the data are such that resources do not permit their use. The procedure is to allocate the county-VMT computed by the analysis described in Projecting County Emissions: Volume 7 of the Guidelines, using the population distribution proportion determined from the residential fuel combustion analysis described in Section 3.1. Since limited access highways have been separated out, this procedure will be fairly accurate for relatively densely populated areas where local traffic outweighs through traffic but should not be used elsewhere. Furthermore, problems will also arise if the subcounty areas are too small (e.g., census tracts) or where the bulk of the traffic in one or more subcounty areas is related to employment density rather than residential density.

In the case of Order 1 computations, the countywide VMT and the limited access highway VMT are derived from completely different sources. The limited access road data are likely to be more accurate since they are based on traffic counts. If a serious discrepancy exists between these two sources, Order 1 computations cannot be done. Additional data must be collected at the county level for the rest of the road network. For example, a primarily rural county with several busy Interstate routes crossing it could get a figure for limited access road VMT that is higher than the countywide VMT estimate based on county fuel sales. Such a discrepancy clearly calls for more data on non-Interstate roads in the county.

Motor Vehicle Data Allocated to Subcounty Areas: Table 3.2-4

1. Fill in the descriptive information at the top of the table (items A through C).

2. In column (1) enter the subcounty area designations following the same order used in Table 3.1-1.

3. In row D the COUNTY TOTAL VMT, for each vehicle type, enter the difference between the countywide VMT computed by the analysis in Projecting County Emissions: Volume 7 and the countywide limited access highway VMT from row D of Table 3.2-2.

4. For each subcounty area and the Residual (described in Section 3.1), multiply the COUNTY TOTAL VMT by the population proportion from column (3), Table 3.1-1, and enter into columns (2), (3) and (4).

5. If any speed data are available for the subcounty areas, enter it in column (5); if no speed data are available, consult the state highway department to recommend average speed estimates.

6. Be sure that the computations are being made using all data from the same year.

Motor Vehicle Emissions Allocated to Subcounty Areas: Table 3.2-5

1. Fill in the descriptive information at the top of the table (items A through C).

2. In column (1) enter the subcounty area designations following the same order as in Table 3.2-4.

3. If subarea speed data are available, determine the speed correction factors for CO, exhaust HC, and NO_x using the speed in column (5) of Table 3.2-4 and the speed correction curves of AP-42. Enter these into columns (8), (12), and (17), respectively. If no speed data are available, enter an estimate in all appropriate columns.

4. Starting with the first subarea, for each vehicle type multiply the VMT from Table 3.2-4 by its emission factor from Table 3.2-1 and record the results on a separate sheet of paper.

5. For LDG and HDG vehicles multiply the results for CO, exhaust HC, and NO_x by the appropriate speed correction factor from columns (8), (12), and (17). Note that there are no speed corrections for diesel vehicles (HDD) or for evaporation HC, SO_x, or particulates.

6. Enter the results for all vehicle types by pollutant into columns (2)-(7), (9)-(11), (13)-(16), and (18)-(20).

7. Repeat steps 4-6 for each subarea.

8. Sum the columns listed in step 6 and enter into the COUNTY TOTAL row (row D) at the bottom of the table.

9. Note that the sum of the COUNTY TOTAL Limited Access Highway Emissions from Table 3.2-3 and the COUNTY TOTAL Motor Vehicle Emissions from this table may not necessarily add up to the countywide emissions computed from the analysis described in Projecting County Emissions: Volume 7. This is due to the more detailed analysis required here for limited access highways.

Allocated Transportation Emissions: Table 3.2-11

NOTE: Instructions for Table 3.2-11 are detailed under Order 3 procedures, after all transportation sources have been considered.

3.2.7 Order 2 Allocations

This Order relies on a more detailed description of the distribution of VMT throughout the country. In general, if this information is available, the countywide totals are drawn from the same source and are the aggregation of all the subarea values. Transportation data presented in this format (i.e., on a grid system) will generally have expressway and arterial VMT separated. The expressway VMT have already been treated in the analysis of limited access highways.

It is assumed that the number of subcounty areas is small enough to be handled by hand calculations.

Motor Vehicle Data Allocated to Subcounty Areas: Table 3.2-4

1. Fill in the descriptive information at the top of the table (items A through C).
2. In column (1) enter the subcounty area designations as given by the transportation planning study in use.
3. For each subarea enter the non-limited-access-highway VMT for each vehicle class in columns (2), (3), and (4).
4. Enter the average vehicle speed in the subarea in column (5).
5. Total columns (2), (3), and (4) and enter into row D, COUNTY TOTAL VMT.

Allocated Transportation Emissions: Table 3.2-11

NOTE: Instructions for Table 3.2-11 are detailed under Order procedures, after all transportation sources have been considered.

3.2.8 Order 3 Allocations

For motor vehicles this Order is the same as Order 2, with the exception that an extensive transportation simulation model is assumed to be available. Computer capability is also assumed available to handle a large number of subcounty areas.

Allocation procedures for all other transportation sources are described here.

Motor Vehicle Data Allocated to Subcounty Areas: Table 3.2-4

1. Complete this table as described under the Order 2 allocation procedures. Computer printouts may be used in place of this table.

Motor Vehicle Emissions Allocated to Subcounty Areas: Table 3.2-5

1. Complete this table as described under the Order 2 allocation procedures. Computer printouts may be used in place of this table.

Airport Emissions: Table 3.2-6

The procedure for allocating airport emissions to subcounty areas is rather straightforward. No subarea grid system is needed for the county. However, there must be a unique way to identify the location of airports within the county and the supporting documentation required to complete the tables in Projecting County Emissions: Volume 7 must be available.

1. Fill in the descriptive information at the top of the table (items A and B).
2. List the name and location of every airport in the county that was considered in the countywide analysis, in column (1). The location can be denoted by the UTM coordinates indicating the southwest corner of a square containing the airport and the length of a side of that square (enter in columns (2) and (3)).

3. Using the data collected at the county level from the analysis of Projecting County Emissions: Volume 7, enter the emissions for each airport directly, into columns (5)-(9). Note that the emission estimates should include all airport sources such as aircraft, ground service vehicles, access traffic, engine test facilities, space heating.

4. If only total county emissions are available from the analysis of Projecting County Emissions: Volume 7, enter these in row D, columns (5)-(9). Determine an aircraft activity proportion of the county total for each airport and enter into column (4). Multiply these proportions by the COUNTY TOTAL and enter the results in the appropriate cell of columns (5)-(9).

In most cases there is no need to treat the airport on other than a total basis. However, certain circumstances may require a finer description of the spatial emission pattern on the airport (e.g., where airport activity is a significant air quality problem). In these cases each airport can be divided into several activity zones (terminal, runways, parking lots, etc.) and the emissions from each activity appropriately assigned.

Railroad Emissions-Track: Table 3.2-7

This table provides for the allocation of rail line emissions, excluding railyards. Railyard emissions will be allocated with the next table. A county with no railyards need only fill out this table. Rail lines are being treated in a similar manner as limited access highways.

1. Fill in the descriptive information at the top of the table (items A through C).

2. For each subcounty area containing track mileage, list the subarea designation in column (1). Use the same designations employed in the motor vehicle emissions allocation (Tables 3.2-4 and 3.2-5).

3. Estimate the proportion of county track mileage in each subarea. Enter this value in column (2).

4. Enter the county totals of railroad emissions from right-of-way (track) operations in row D, COUNTY TOTAL, from the analysis of Projecting County Emissions.

5. For each subarea, multiply the proportion from column (2) by the COUNTY TOTAL for each pollutant. Enter these figures in columns (3) through (7).

Railroad Emissions-Yards: Table 3.2-8

This table provides for the allocation of railyard emissions. The county total can be obtained from the analysis using Projecting County Emissions: Volume 7 of the Guidelines. Draw a square around each railyard and determine the coordinate of the southwest corner and the length of one side. Similar to airports, countywide railyard emissions calculated per Projecting County Emissions: Volume 7 are apportioned according to the relative size of each railyard plot.

1. Fill in the descriptive information at the top of the table (items A and B).
2. List all yards in columns (1), (2), and (3), by name, coordinate and length of side, respectively.
3. Estimate the proportion of county railroad yard track mileage for each yard and list in column (4).
4. Enter the county total of emissions from railyards in the COUNTY TOTAL row (row D) from the analysis of Projecting County Emissions: Volume 7.
5. Multiply the proportion by the COUNTY TOTAL for each pollutant, for each railyard. Enter the results in columns (5) through (9).

Sea Vessel Emissions: Table 3.2-9

Sea vessels include both private recreational and commercial/industrial vessels. Given the county emissions totals for each of these categories from the analysis per Volume 7 of the Guidelines the allocation is straightforward.

The bases for allocation are as follows:

a. inland water surface used for recreational boating

b. tonnage for commercial boating

c. miles of shoreline along rivers, lakes, ocean

d. boat registrations (recreational boating)

The first three are preferred; boats are often not used in the place of registration. The entries for this table are filled in as follows:

1. Fill in the descriptive information at the top of the table (items A and B).
2. Enter the name or coordinates (if grid cells are used) of the subareas in column (1).
3. Enter the county emission totals in the COUNTY TOTAL row (row D).
4. Compute the proportion of activity for each subarea and enter it in column (2). If more than one type of vessel contributes significantly to the subarea's emissions, compute a separate proportion for each type. Hence, there may be more than one entry per subarea. Remember to scale the fractions so that all proportions sum to 1.0. That is, if there is significant recreational and commercial vessel activity in the ratio of .25/.75, then the proportion of total recreational activity should be multiplied by .25 to make it represent the true proportion of total vessel activity.
5. Multiply the proportion from column (2) by the COUNTY TOTAL for each pollutant. Enter this in the appropriate column (columns (3) through (7)).

Off-highway Vehicle Emissions: Table 3.2-10

This category includes lawn mowers, garden tractors, farm vehicles, construction vehicles and similar mobile sources of air pollutant emissions. The allocation technique is primarily a population based allocation of emissions computed as described in Projecting County Emissions: Volume 7. If lawn vehicles and construction vehicles are a significant component (over 10%) of this category, a separate allocation should be done (see step 4 below).

1. Fill in the descriptive information at the top of the table (items A and B).
2. List the subcounty areas in column (1), in the same order as for Table 3.1-1 of this report.
3. Enter the countywide emissions for this source category determined by the analysis from Volume 7 of the Guidelines TOTAL.
4. Multiply the population allocation proportion (Table 3.1-1), column (3) by the COUNTY TOTAL and enter the results in columns (3)-(7).
5. If farm and construction vehicles are significant, determine for each subarea the proportion of tractors or construction employees. Enter the proportion in column (2). Use a separate line for each such proportion for each subarea. Multiply the proportion by the COUNTY TOTAL and add this to the previously computed emissions (step 4) from home-use mobile sources. Enter this total for each pollutant into columns (3)-(7).

Allocated Transportation Emissions: Table 3.2-11

1. Fill in the descriptive information at the top of the table (items A through C).

2. List all subareas in column (1) using the same designations and following the same sequence employed in Table 3.2-5.

3. Handling each subarea sequentially, compute total transportation emissions for each pollutant using the following steps:

   a. Obtain non-limited-access VMT emissions for the first pollutant (e.g., particulates) from Table 3.2-4.

   b. For the limited-access-highway line segments defined in Table 3.2-3, determine the portion of each line segment (and therefore its pollutant-specific emissions) lying in each subarea. Since these segment-specific particulate emissions for the subarea in question and add them to the particulate emissions determined in step 3a.

   c. For all other transportation sources (Tables 3.2-6 through 3.2-10), determine the portion of each area and/or line segment (and therefore its pollutant-specific emissions) lying in each subarea. Since these area and/or line-segment particulate emissions for the subarea in question and add them to the particulate emissions determined from steps 3a and 3b.

   d. After summing the particulate emissions over all types of transportation sources considered, enter the total emissions for the subarea in Table 3.2-11.

   e. Continuing with the same subarea, sum the emission levels for sulfur oxides, carbon monoxide, etc., repeating steps 3a through 3d until all pollutants are completed.

   f. Go to the next subcounty area and repeat steps 3a through 3e. Continue until total transportation emissions have been summed for all subareas, the TOTAL for all subareas, the Residual, and the COUNTY TOTAL.

3.3 COMMERCIAL/INSTITUTIONAL FUEL COMBUSTION EMISSIONS

3.3.1 Introduction

The allocation of emissions from fuel combustion in commercial/institutional buildings must be treated with some caution. It can, in general, be said that commercial and institutional development follows the distribution of population. There are, however, specialized situations where such a broad assumption can lead to erroneous results. A large urban central business district and a regional shopping center are two examples of commercial development locating in an area of low population density.

To minimize the impact of such distortions the treatment of commercial/institutional sources requires the separation of large, point sources prior to the allocation of the fuel use to subcounty areas. This procedure presents no unusual problems since large sources should already be identified on the point source inventory. The allocation of the remaining emissions is analogous to the allocation of residential fuel combustion.

3.3.2 Data Requirements

Data required for each of the three allocation Orders are as follows:

All Orders:

a. Location and fuel use of large commercial/institutions sources from point source file.

Order 1:

a. Actual and projected population for each specified subcounty area. (Sources: U.S. Census of Population state, regional and local planning agencies.)

b. County totals (actual and projected) of fuel used for commercial and institutional space heating. (Source: Projecting County Emissions: Volume 7 of the Guidelines.)

Order 2:

a. Actual and projected commercial/institutional employed persons for each specified subarea within the country. (Sources: U.S. Census of Population, state, regional and local planning agencies.)

b. County totals (actual and projected) of fuel used for commercial and institutional space heating. (Source: same as for Order 1.)

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Order 3:

a. Actual and projected number of commercial and institutional establishments for each specified subcounty area. (Sources: state and local planning agencies and/or Bureaus of Labor.)

b. Actual and projected commercial/institutional building size distribution (classified by square foot floor area of establishments) for each specified subcounty area. (Sources: state and local planning agencies.)

c. Actual and projected commercial/institutional fuel use distribution for each specified subcounty area. (Sources: state and local planning agencies, utilities.)

d. Total degree-days for the region under study. (Source: Climatic Atlas of the United States.

3.3.3 Procedural Overview

Figure 3.3-1 diagrams the sequence in which the various tables will be used in allocating commercial/institutional emissions to subcounty areas for each order of computation. In all three allocation Orders the large commercial and institutional sources are first separated out using the point source file. The fuel used in these sources is subtracted from the county total. In an Order 1 allocation procedure the remaining fuel use is allocated according to the population distribution. In Order 2 an employment distribution is used as the allocation parameter. In Order 3 the number of commercial/institutional buildings in each subcounty area is determined along with building size and fuel use distributions. Fuel consumption factors are applied and fuel use is computed. The county fuel totals are then used as mass balance checks.

It is important to note that for allocation Orders 2 and 3, it is not necessary to use the same set of subcounty areas as the population distribution. If commercial/institutional data are available on a different grid network then they may be used as provided. All subcounty areas are made comparable using a coordination of all the master gridding techniques described in Section 4.

The three Orders for allocating these emissions closely parallel procedures used in allocating residential space heating emissions to subcounty areas. Therefore, in the interest of economy the tables used to allocate commercial/institutional emissions are discussed only briefly below for each

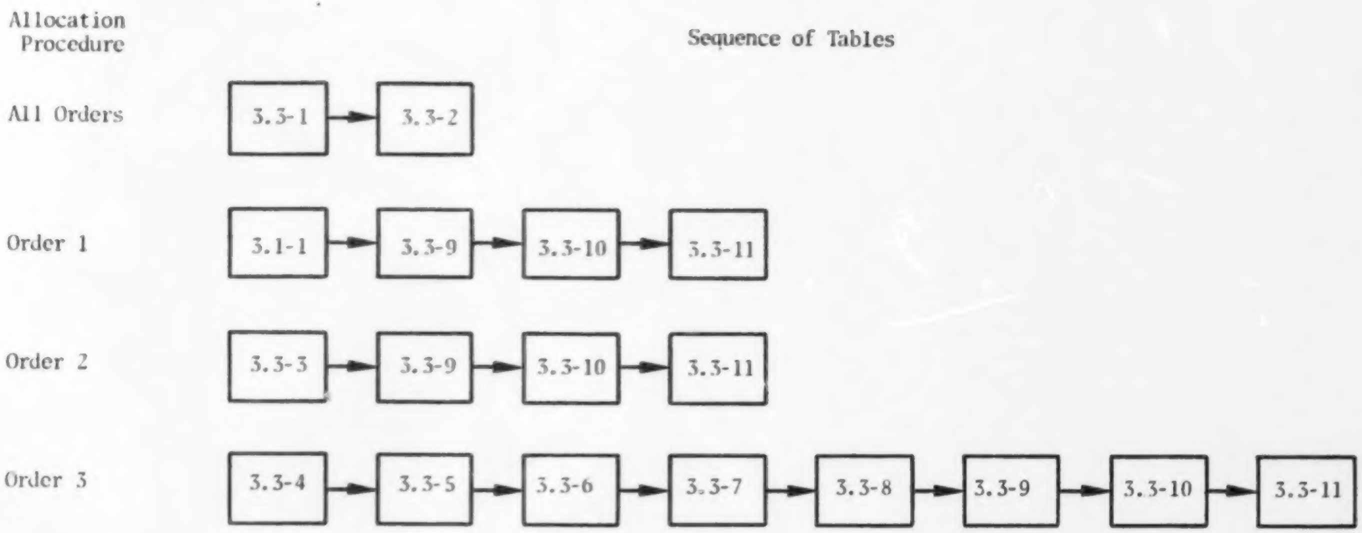
Allocation Procedure
Sequence of Tables
All Orders
3.3-1
3.3-2
Order 1
3.1-1
3.3-9
3.3-10
3.3-11
Order 2
3.3-3
3.3-9
3.3-10
3.3-11
Order 3
3.3-4
3.3-5
3.3-6
3.3-7
3.3-8
3.3-9
3.3-10
3.3-11

Figure 3.3-1 Commercial/Institutional Fuel Combustion Allocation Table Sequence

Order. The user is referred back to appropriate portions of Section 3.1 where the mechanics for using analogous tables are detailed step-by-step.

3.3.4 Commercial/Institutional Point Sources

The fuel use and emissions from these sources are determined from the point source file. If information is available on the location of new point sources then this can be incorporated into the tables for projection years.

It is entirely possible that the point source file will contain no commercial/institutional sources. In this case it can be assumed that all sources are small and their emissions can be allocated by one of the three Orders.

Commercial/Institutional Point Source Fuel Use: Table 3.3-1

1. Fill in the descriptive information at the top of the table (items A through B).
2. Enter the source name in column (1).
3. Enter the source coordinate in column (2). (UTM grid coordinates are recommended.)
4. From the point source file enter in the appropriate column the annual fuel used by each source.
5. Sum columns (3)-(8) for all point sources and enter into the COUNTY TOTAL row.

Commercial/Institutional Point Source Emissions: Table 3.3-2

1. Fill in the descriptive information at the top of the table (items A and B).
2. Enter the source name in column (1) following the same sequence used in Table 3.3-1.
3. From the point source file enter the emissions for each source.
4. Sum columns (2)-(6) and enter into the COUNTY TOTAL row.

Table 3.3-1

Commercial/Institutional Point Source Fuel Use

A. County ______________

B. Year ______________

C. Allocation Order 1, 2 and 3

(1) Source	(2) Coordinates		Coal (tons/yr)			Oil (10^3 gals/yr)		Natural Gas (10^6 ft^3/yr) (8)
	X	Y	(3) Anthracite	(4) Bituminous	(5) Lignite	(6) Distillate	(7) Residual	
COUNTY POINT SOURCE TOTAL								

Table 3.3-2

Commercial/Institutional Point Source Emissions

County ____________________
Year ______________________
Allocation Order 1, 2 and 3

	Emissions (tons/yr)				
(1) Source	(2) Part.	(3) SO_x	(4) CO	(5) HC	(6) NO_x
SUBAREA TOTAL					

Table 3.3-3

Commercial/Institutional Employment-Based Allocation Proportions for Subcounty Areas

A. County ________________
B. Year ________________
C. Allocation Order 2

(1) Subarea	(2) Commercial/ Institutional Employment	(3) Allocation Proportion
SUBAREA TOTAL		
Residual		
D. COUNTY TOTAL		1.0

Table 3.3-4

Number of Commercial/Institutional Establishments in Subcounty Areas

A. County ______________
B. Year ______________
C. Allocation Order 3

(1) Subarea	(2) Number of Commercial/ Institutional Establishments
SUBAREA TOTAL	
Residual [1]	
D. COUNTY TOTAL	

Table 3.3-5

Commercial/Institutional Building Size Distribution

A. County
B. Year
C. Allocation Order

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(1)	Commercial/Institutional Establishments by Building Size[1]												Total Establishments (8)
Subarea	(2)		(3)		(4)		(5)		(6)		(7)		
	Number	Proportion	Number	Proportion	Number	Proportion	Number	Proportion	Number	Proportion	Number	Proportion	
SUBAREA TOTAL													
Residual													
COUNTY TOTAL													

---

[1] Building size categories are arbitrary. User must specify intervals for floor area per building based on considerations of data availability, level of detail desired and time required for computation.

Table 3.3-6

Commercial/Institutional Fuel Use Distribution

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	Commercial/Institutional Establishments by Fuel Use																Total Establishments
	Coal						Oil				Natural Gas		Electricity		Other		
	Bituminous		Anthracite		Lignite		Distillate		Residual								
Subarea	Number	Proportion	Number	Proportion	Number	Proportion	Number	Proportion	Number	Proportion	Number	Proportion	Number	Proportion	Number	Proportion	
SUBAREA TOTAL																	
[illegible]																	
COUNTY TOTAL																	

Table 3.3-7
Commercial/Institutional Fuel Use Factors by Building Size

A. County ______
B. Year ______
C. Allocation Order 3

	Fuel Use Factors					
	Coal (lbs/degree-day)			Oil (gals/degree-day)		Natural Gas (ft^3/degree-day)
(1) Ft^2 Floor Area per Establishment[1]	(2) Anthracite	(3) Bituminous	(4) Lignite	(5) Distillate	(6) Residual	(7)

---

[1] User must specify building size categories in accordance with those specified in Table 3.1-3.

Table 3.3-8

Annual Commercial/Institutional Fuel Use By Building Size

A. County ____________
B. Year ____________
C. Allocation Order 3

	Annual Fuel Use					
	Coal (tons/yr)			Oil (10^3 gal/yr)		Natural Gas (10^6 ft^3/yr)
(1) Ft^2 Floor Area per Establishment[1]	(2) Anthracite	(3) Bituminous	(4) Lignite	(5) Distillate	(6) Residual	(7)

---

[1] User must specify building size categories in accordance with those specified in Table 3.3-5.

Table 3.3-9

Commercial/Institutional Fuel Use Allocated to Subcounty Areas

A. County ________________
B. Year ________________
C. Allocation Order 1, 2, and 3

	Annual Fuel Use					
	Coal (tons/yr)			Oil (10^3 gal/yr)		Natural Gas (10^6 ft^3/yr)
(1) Subarea	(2) Anthracite	(3) Bituminous	(4) Lignite	(5) Distillate	(6) Residual	(7)
SUBAREA TOTAL						
Residual						
D. ACTUAL COUNTY TOTAL						
E. COMPUTED COUNTY TOTAL[1]						

---

[1] This row will be used only in cases where an Order 3 allocation procedure is being followed.

Table 3.3-10
Commercial/Institutional Fuel Combustion Emission Factors

A. County ____________________

B. Year ____________________

C. Allocation orders 1, 2 and 3

		Emission Factors				
(1)		(2) Part.	(3) SO_x	(4) CO	(5) HC	(6) NO_x
Coal	Anthracite					
	Bituminous					
	Lignite					
Oil	Distillate					
	Residual					
Natural Gas						

Table 3.3-11
Commercial/Institutional Fuel Combustion Emissions Allocated to Sub-County Areas

A. County ____________________

B. Year ____________________

C. Allocation Order 1, 2 and 3

	Emissions (tons/yr)				
(1) Subarea	(2) Part.	(3) SO_x	(4) CO	(5) HC	(6) NO_x
SUBAREA TOTAL					
Residual					
D. COUNTY TOTAL					

3.3.5 Order 1 Allocations

Order 1 provides the least extensive method for allocating commercial/institutional emissions to subcounty areas. The total amount of commercial/institutional space heating fuels used throughout the county are allocated among subcounty areas according to the population distribution. This procedure is not significantly inaccurate if the subcounty areas are not too small. For small subareas (e.g., census tracts) this is likely to produce erratic results because of specialized commercial developments. Consideration should be given to aggregating small areas when this procedure is to be used.

Commercial/Institutional Fuel Use: Table 3.3-9

1. Fill in the descriptive information at the top of the table (items A through C).
2. In column (1) enter the subcounty area designations following the same sequence as employed in Table 3.1-1.
3. In columns (2)-(7) of row D, COUNTY TOTALS, enter the difference between the countywide commercial/institutional fuel use computed using the analysis from Projecting County Emissions: Volume 7 and the point source countywide fuel use totals of Table 3.3-1.
4. Allocate the fuel use to the subcounty areas and the Residual using the population allocation proportions of Table 3.1-1. (Refer to Table 3.1-7 for detailed instructions.)

Commercial/Institutional Fuel Combustion Emission Factors: Table 3.3-10

1. Enter the appropriate commercial/institutional emission factors from Compilation of Air Pollutant Emission Factors (AP-42). Again, the user is cautioned to check that the latest edition or supplement to AP-42 is employed as this document is constantly being updated.

3.3.6 Order 2 Allocations

Order 2 provides the intermediate method for allocating commercial/institutional emissions to subcounty areas. Non-point source commercial/institutional fuel use is distributed among subcounty areas according to commercial/institutional employment distribution rather than the population distribution. If it is convenient to use a subcounty area grid that is different from the population grid, this may be done with no procedural difficulties.

Commercial/Institutional Employment-based Allocation Proportions: Table 3.3-3

1. Fill in the descriptive information at the top of the table (items A through C).
2. In column (1) enter the selected subcounty area designations.
3. In column (2) enter the commercial/institutional employment in each subarea and in the Residual.
4. Compute the employment allocation proportion and enter into column (3) by dividing the subarea employment by the COUNTY TOTAL in row D. (Refer to Table 3.1-1 for analogous detailed instructions).

Commercial/Institutional Fuel Use: Table 3.3-9

1. Fill in the descriptive information at the top of the table (items A through C).
2. In column (1) enter the subcounty area designations following the same sequence as employed in Table 3.3-3.
3. In columns (2)-(7) of row D, COUNTY TOTAL, enter the difference between the countywide commercial/institutional fuel use computed using the analysis from Projecting County Emissions: Volume 7 countywide fuel use of Table 3.3-1.
4. Allocate the fuel use to the subcounty areas using the commercial/institutional employment allocation proportions of Table 3.3-3. (See analogous operation in description of Table 3.1-7).

Commercial/Institutional Emission Factors: Table 3.3-10

1. Enter the appropriate commercial/institutional emission factors from Compilation of Air Pollutant Emission Factors, AP-42.

Commercial/Institutional Fuel Combustion Emissions: Table 3.3-11

1. Fill in the descriptive information at the top of the table.
2. Multiply the fuel use of Table 3.3-9 by the emission factors of Table 3.3-10 and enter in the appropriate columns. (Refer to Table 3.1-9 for detailed instructions.)

3.3.7 Order 3 Allocations

Order 3 constitutes the most extensive method for allocating commercial/institutional emissions to subcounty areas. Three pieces of information are required for each subcounty area: (1) the number of commercial/institutional establishments, (2) the building size distribution, and (3) the fuel use distribution. This procedure is analogous to the Order 3 residential fuel combustion emission allocation in that the commercial/institutional fuel use is computed for each subcounty area and then checked against the countywide totals.

Number of Commercial/Institutional Establishments: Table 3.3-4

1. Fill in the descriptive information at the top of the table (items A through C).
2. List all subcounty areas in column (1).
3. Enter the number of commercial/institutional establishments (actual for past or present year(s) and projected for future years) for each subcounty area and the Residual in column (2). (Refer to Table 3.1-2, Order 3 Residential Fuel Combustion, for detailed instructions.)

Commercial/Institutional Building Size Distribution: Table 3.3-5

1. Fill in the descriptive information at the top of the table (items A through C).
2. Specify building size categories (by square feet of commercial/institutional space) along the top row of the table. The columns of this row are left blank so that the user can employ the best building size data at his disposal.
3. List all subcounty areas in column (1) following the same sequence as employed in Table 3.3-4.
4. In the left column of the various building size categories record the number of establishments in that category. In the right column record this number divided by the subarea total. (Refer to Table 3.1-3 for detailed instructions.)

Commercial/Institutional Fuel Use Distribution: Table 3.3-6

1. Fill in the descriptive information at the top of the table. (items A through C).
2. List all subcounty areas in column (1).
3. In the left column for the various kinds of fuel record the number of establishments using each fuel. In the right column record this number divided by the subarea total. (Refer to Table 3.1-4 for detailed instructions.)

Annual Commercial/Institutional Fuel Use By Building Size and Fuel Used: Tables 3.3-7 and 3.3-8

These tables are completed in an analogous fashion to Tables 3.1-5 and 3.1-6 for residential fuel use. These tables are filled in only once for the entire county.

Lacking any more specific data the following assumptions can be employed in generating the fuel use factors to be entered in Table 3.3-7:

a. The average heating requirement for commercial/institutional establishments is given by the following table:

Floor Space ($10^3 ft^2$)	Heating Requirement (HR) (10^6 Btu/degree-day)
0 -20	1.53
20 -50	1.80
50 -100	2.24
100+	3.07

b. Each type of fuel has the following heating values (HV):

coal	11,000 Btu/lb.
oil	144,000 Btu/gal.
natural gas	800 Btu/ft^3

c. Heating plant efficiency HPE:

coal	65%
oil	75%
natural gas	80%

Employing these assumptions the total annual fuel requirements are computed for each building size category by calculating a fuel use factor.

$$FUF_{ij} = \frac{HR_i}{HV_i \times HPE_i}$$

where FUF_{ij} = Fuel use factor for fuel i, building size j

HR_j = Heating requirement for building size j

HV_i = Heating value for fuel i

HPE_i = Heating plant efficiency for fuel i

If the above assumptions are used then the following values should be entered in Table 3.3-7. If more region-specific data are available then Table 3.3-7 can be filled in with that information using the above calculation procedure.

FUEL USE FACTORS (FUF)

Floor Space ($10^3 ft^2$)	Coal (lbs/degree-day)	Oil (gals/degree-day)	Natural-Gas (ft^3/degree-day)
0-20	214	14	2390
20-50	252	17	2813
50-100	313	21	3500
100-200	429	28	4797

The annual fuel requirements for each type of fuel for each building size category can now be computed by multiplying the values in Table 3.3-7 by the number of degree-days per year in the region. The results are entered in Table 3.3-8.

Commercial/Institutional Fuel Use: Table 3.3-9

1. Fill in the descriptive information at the top of the table (items A through C).
2. In column (1) enter the subcounty area designations following the same sequence as employed in Table 3.3-4.
3. For each subarea and the Residual multiply the number of establishments from Table 3.3-4 by the building size distribution from Table 3.3-5 and by the fuel use distribution from Table 3.3-6. Multiply this result by the annual fuel use requirement from Table 3.3-8. Sum over all building size categories and enter into the appropriate column of Table 3.3-9 (Refer to Table 3.1-7 for detailed instructions.)
4. Check the computed COUNTY TOTAL fuel use against the ACTUAL COUNTY TOTAL. Adjust as described for Table 3.1-7.

Commercial/Institutional Fuel Combustion Emission Factors: Table 3.3-10

1. Fill in as described in Order 1 allocation procedures.

Allocated Commercial/Institutional Fuel Combustion Emissions: Table 3.3-11

1. Fill in as described in Order 1 allocation procedures.

3.4 INDUSTRIAL EMISSIONS

This section treats the allocation of industrial emissions. Industrial emissions are divided into two categories -- process and fuel combustion. While the procedures for each category are similar, enough variation in calculation exists to warrant separation. Also, an individual point source may be either predominantly a process source or a fuel combustion source, or both.

The tables for this section have been designed to use the OBERS economic projections as developed by the U.S. Departments of Commerce and Agriculture. Flexibility has also been provided in the forms to allow for the use of other growth forecasts if more consistent and accurate data are available on the state or local levels. Finally, these tables have also been designed to fit as closely as possible the countywide projection procedures as contained in Volume 7 of the Guidelines Projecting County Emissions.

3.4.1 Industrial Process Sources

3.4.1.1 Introduction

This section describes procedures for allocating major industrial process emissions. Consistent with other portions of this document, three Orders of analysis have been provided to allow for a diversity of growth possibilities and a range of available data.

In each order, an estimate of the rate of growth must be derived from available forecasts (e.g., OBERS) for each industrial process category to be analyzed. If this rate of growth is small (or declining), the resulting emissions can be assumed to be generated by existing sources and an Order 1 analysis can be used.

If, on the other hand, the rate of growth is significant, an Order 2 or Order 3 analysis should be used. These orders require an estimate of the percentage of growth that will occur in existing sources and that which will occur in new sources. For the Order 2 analysis, it may be possible to generate the estimates using planning agency data. For example, if new areas of industrial development can be forecast, the fraction of growth in new sources can be estimated as the ratio of new industrial land development to emissions from existing industrial land use, assuming that the emission growth is approximately proportional to industrial land use growth. For the Order 3

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analysis, expansion plans and possible new source locations are determined directly from field interviews of major existing point sources.

In both the Order 2 and Order 3 analysis, the Residual growth at new sources is allocated to subareas on the basis of projected land use or employment levels in each subarea. While a recent Argonne study, *Methods for Predicting Air Pollution Concentrations from Land Use*, failed to yield systematic relationships between these planning variables and emissions, their use as allocation factors are recommended until better indications of emissions are available simply because they are in common use as measures of industrial activity.

3.4.1.2 Data Requirements

Data required for each of the three allocation orders are as follows:

Order 1

a. Growth rates for each of the major process sources for each of the horizon years.
   Sources:
   (1) OBERS projections by process source category or SCC process categories defined in the USEPA publication *Guide for Compiling a Comprehensive Emissions Inventory*
   (2) Special planning studies
   (3) Chambers of Commerce
   (4) Plant interviews

b. File of existing point sources (location, process category, and process emissions for each pollutant).
   Source:
   (1) State air pollution control agencies
   (2) USEPA-NEDS file described in the USEPA publication *Guide For Compiling a Comprehensive Emissions Inventory*

Order 2

a. As in Order 1

b. As in Order 1

c. Employment or land use for existing sources.
   Source: Plant interviews

d. Employment levels or land use by process source category and geographic grid subarea.
   Sources:
   (1) Area planning studies
   (2) Manufacturers Directories
   (3) Social Security Offices
   (4) Unemployment Compensation Offices

e. Estimates of fractions of existing and new source growth.
Source: Area planning studies

Order 3

a. As in Order 1

b. As in Order 1

c. As in Order 2

d. As in Order 2

e. Expansion plans for existing major point sources or potential new point sources.
Source: Plant interviews

3.4.1.3 Procedural Overview

Figure 3.4-1 diagrams the sequence of table use for allocating industrial process source emissions for each of the three allocation Orders. The first case, or Order 1 analysis, simply allocates growth to existing (or identifiable) process point sources; that is, the assumption is made that new growth will not be significant and that the location and other expansion characteristics of all new sources to be constructed during the planning horizon can be explicitly determined. In the absence of source specific growth rates, growth rates aggregated by process category may be used. For example, the Standard Industrial Classification Codes (SIC) or the OBERS projection categories may be used. Category growth rates may then be applied uniformly to all point sources in each category assuming that proportional shares of the baseline emissions are maintained over the planning horizon. The definition of process categories is purposely left open to fit local data base definitions and requirements.

The Order 2 and 3 analyses assume that an estimate of the fraction of growth attributable to existing sources can be determined in addition to total process category growth. Order 2 generates these estimates from planning studies while Order 3 makes use of field interview data. Both orders forecast the point source growth in process emissions first and then allocate the new source growth (if any) to subareas as a function of employment or land use by process category. The aid of the county planning agency should be enlisted to devise employment or land use forecasts by subarea and process category for

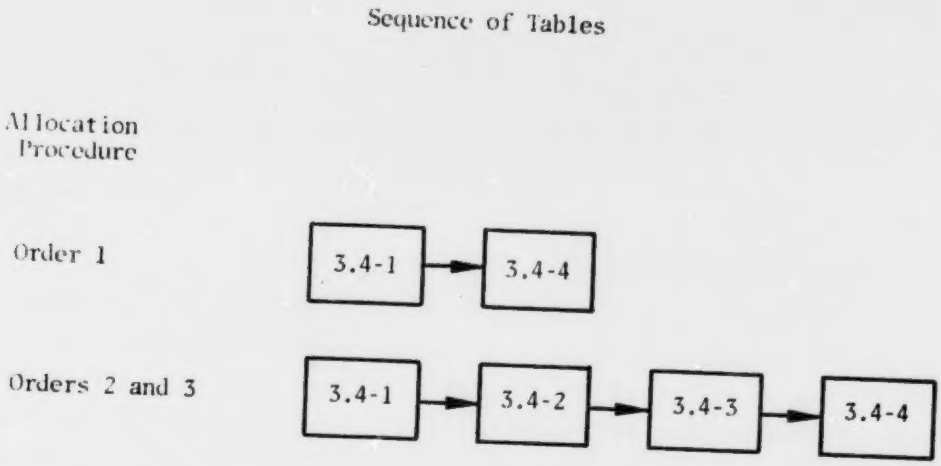
Sequence of Tables
Allocation Procedure
Order 1
3.4-1
3.4-4
Orders 2 and 3
3.4-1
3.4-2
3.4-3
3.4-4

Figure 3.4-1 Industrial Process Allocation Table Sequence

the planning horizon. Differences in definitions of industrial process categories and geographical scale must be reconciled at this time. The level of detail in process category definition and subarea size should be as "fine" as available data will allow.

Table 3.4-1

Point Source Industrial Process Emissions

A. County ______________
B. Year ______________
C. Allocation Order 1, 2, and 3

(1) Industrial Process Category	Source Identification					Process Emission Forecast (tons/yr)											
	(2) Name	(3) Process	(4) Subarea	(5) Coord.		(6)	(7) Part.		(8) SO_x		(9) CO		(10) HC		(11) NO_x		(12)
				X	Y	GF**	Cont.	Emis.	Cont.	Emis.	Cont.	Emis.	Cont.	Emis.	Cont.	Emis.	Emp.*

*Employment
**Growth Factor

Table 3.4-2

Industrial Point and New Source Process Emissions by Process Category

A. County __________
B. Year __________
C. Allocation Order 2 and 3

(1) Industrial Process Category	Baseline Year Existing Point Sources						Forecast Year - All Sources							Forecast Year Existing Point Sources						Forecast Year - New Sources										
	(2) Part.	(3) SO_x	(4) CO	(5) HC	(6) NO_x	(7) Emp.*	(8) GF**	(9) Part.	(10) SO_x	(11) CO	(12) HC	(13) NO_x	(14) Emp.*	(15) Part.	(16) SO_x	(17) CO	(18) HC	(19) NO_x	(20) Emp.*	(21) Part.		(22) SO_x		(23) CO		(24) HC		(25) NO_x		(26)
																				Cont.	Emis.	Cont.	Emis.	Cont.	Emis.	Cont.	Emis.	Cont.	Emis.	Emp.*
D. COUNTY TOTAL							▨																							

* Employment
**Growth Factor

Table 3.4-3

Process Emissions by Process Category and Subarea

A. County ____________________
B. Subarea ____________________
C. Year ____________________
D. Allocation Order __2 and 3__

Industrial Process Category (1)	Total Emp. (2)	Point Source Emp. (3)	New Source Emp. (4)	EAP* (5)	New Source Emissions (tons/yr)				
					(6) Part.	(7) SO_x	(8) CO	(9) HC	(10) NO_x
E. SUBAREA TOTAL									

*Employment Allocation Proportion = $\frac{\text{Subarea Category New Source Employment}}{\text{Total Category New Source Employment}}$

Table 3.4-4

Industrial Point and New Source Process Emissions - Subarea Summary

Reproduced from best available copy.

A. County ________________
B. Subarea ________________
C. Year ________________
D. Allocation Order 1, 2, and 3

Industrial Process Category (1)	Point Source Emissions							New Source Emissions						Total Emissions					
	(2) No. of Sources	(3) Emp.*	(4) Part.	(5) SO_x	(6) CO	(7) HC	(8) NO_x	(9) Emp.*	(10) Part.	(11) SO_x	(12) CO	(13) HC	(14) NO_x	(15) Emp.*	(16) Part.	(17) SO_x	(18) CO	(19) HC	(20) NO_x
E. SUBAREA TOTAL																			

*Employment

3.4.1.4 Order 1 Allocations

The first method of allocation assumes that growth (or decline) in an industrial category occurs at the same location as existing facilities in the point source file. The following method assumes that point source data has been updated to the baseline year.

Industrial Point Source Process Emissions: Table 3.4-1

One set of tables should be filled out for all major point sources for the baseline year and each of the forecast years. If sources have been segregated into process categories, it is best to record one category per sheet and total the results of each category on the top line of the form.

1. Fill in the descriptive information at the top of the table (items A through C) and the process category in column (1) if applicable.
2. Enter the name, process identification, subarea and coordinates for all of the significant point sources on the point source file in columns (2)-(3), respectively. In column (3) the process identification can be the SIC code, SCC code, or some other descriptive identification.
3. In column (6) enter the growth factor corresponding to the individual process identification, if available; otherwise, apply the process category growth factor uniformly to each source within a given process category. Fill out the table for the baseline year first (in which case the growth factors are 1.0). Fill out tables for forecast years with the corresponding growth factors.
4. Enter the proportional reduction in emissions (e.g., 1.0 minus the estimated proportional reduction in emissions due to pollution control regulations) for each pollutant relative to the baseline year for each process in the left hand side of columns (7)-(11). Compute forecast year emissions as the product of baseline year emissions, the growth factor, and the controls reduction factor and enter this result in the right hand side of columns (7)-(11).
5. Sum and record total point source process emissions for each process category on the bottom line of each form.

Industrial Point and New Source Process Emissions-Subarea Summary: Table 3.4-4

Table 3.4-4 merely provides a summary of emissions (in this case, point sources only) by subarea. Record the sum of appropriate point source process emissions by subarea determined from Table 3.4-1 in columns (2)-(8) and sum over subareas to obtain countywide totals. No new source process emissions exist for the Order 1 analysis.

3.4.1.5 Order 2 Allocations

An Order 2 allocation assumes that the fraction of growth that will be accounted for by new sources and the amount attributable to existing sources can be estimated if the growth in a given process category is significant. Employment (or land use) for the baseline year should be obtained for the existing point sources if it is not already known. Forecast employment (or land use) by process category and subarea should be obtained from area planning studies or from the responsible planning agency. The subcounty area set on which this information is displayed may be one of those used previously or an entirely new set.

Industrial Point Source Process Emissions: Table 3.4-1

1. Fill in following Order 1 procedures and include employment (or land use) for each point source, in column (12). Sum over all point sources for each category. For forecast years, use the estimated growth factors for existing sources.

Industrial Point and New Source Process Emissions By Process Category: Table 3.4-2

1. Fill in the descriptive information at the top of the table (items A through C).
2. In column (1) enter the process category identification (SIC, SOC, etc.) for growth factors which are greater than 1.0.
3. In columns (2)-(6) enter the emissions and in column (7) the employment from each process category for the baseline year. This information is obtained by summing the emissions and employment over all individual sources in each process category from Table 3.4-1.
4. Enter the total growth factor for each process category in column (8).

5. Compute the forecast year emissions and employment (or land use) for all sources in each process category by multiplying the baseline year process emissions and employment (or land use) by the growth factors. Enter the results in columns (9)-(14). (Employment or land use projections may also be available from the area planning studies.

6. Record total process category growth in process emissions and employment (or land use) at existing sources from Table 3.4-1 in columns (15)-(20) for the appropriate forecast year.

7. Estimate the proportional reduction in emissions in each process category due to new source control regulations and record 1.0 minus this proportional reduction in emissions in the left hand side of columns (21)-(25).

8. Compute the forecast year new source emissions by subtracting columns (15)-(19) from columns (9)-(13). Multiply these results by the control factor in the left hand side of columns (21)-(25) and enter the result into the right hand side of these columns. (These new source emissions will be allocated in subcounty areas on the basis of employment or land use.) If any of the computations result in a negative emission, enter a zero in the column.

9. Compute the new source employment (or land use) as the difference between columns (14) and (20) and enter in column (26).

10. Repeat steps 1-9 for each forecast year.

Industrial New Source Process Emissions by Process Category and Subarea: Table 3.4-3

1. Fill in the descriptive information at the top of the table (items A through D). Note that a separate table will be filled out for each subcounty area.

2. In column (1) enter the process category identification (SIC, SCC, etc.) from column (1) in Table 3.4-2.

3. In column (2) enter the total process category employment (or land use) in the subarea as determined from area planning studies. This must be consistent with the data source used in developing entries (9)-(14) of Table 3.4-2.

4. In column (3) enter the existing point source process category employment (or land use) by identifying sources located in the subarea from Table 3.4-1.

5. Compute the new source process category employment (or land use) as the difference between columns (2) and (3) and enter in column (4). Record zero if the result is negative.

6. Compute the new source process category employment (or land use) allocation proportion (EAP) as the ratio of the values in column (4) to the county total new source process category employment (or land use) column (26) of Table 3.4-2. Enter these results in column (5).

7. Compute the new source emissions in the subarea by multiplying the total process category new source emissions from columns (21)-(25) of Table 3.4-2 by the EAP of column (5). Enter the results in columns (6)-(10).

Industrial Point and New Source Process Emissions-Subarea Summary: Table 3.4-4

1. In each subarea, record existing point source process emissions and new source subarea process emissions, and sum to yield subarea totals.

2. Sum over subareas to yield county totals and check these with the totals in Table 3.4-2.

3.4.1.6 Order 3 Allocations

Order 3 allocation procedures follow the same general format as Order 2 procedures except that point source field interview data is used in the analysis to estimate the fraction of growth of existing sources. The remaining growth is allocated to new sources following the Order 2 employment (or land use) based allocation procedures.

Industrial Point Source Process Emissions: Table 3.4-1

1. Fill in following Order 1 procedures. Note that if the plant survey gives an indication of new point source locations these should be included in the appropriate tables.

Industrial Point Source and New Source Process Emissions by Process Category: Table 3.4-2

1. Fill in according to steps 1-5 of Order 2 procedures.

2. Columns (15)-(20) are filled in using data for the appropriate year from Table 3.4-1. These columns now represent emissions resulting from increased output at existing and new point sources. This information is obtained from the plant survey.

3. Continue with remainder of Order 2 procedures.

Industrial New Source Process Emissions by Process Category and Subarea: Table 3.4-3

1. Fill in according to Order 2 procedures.

Industrial Point and New Source Process Emissions-Subarea Summary: Table 3.4-4

1. Fill in according to Order 2 procedures.

3.4.2 Industrial Fuel Combustion Emissions

3.4.2.1 Introduction

Industrial fuel combustion emissions are divided into point source and area source components. The methods for allocating fuel use and fuel combustion emissions are similar to those used for industrial process emissions; i.e., fuel demand and fuel combustion emissions are estimated first for existing major point industrial fuel combustion sources and the remainder is allocated to new sources as a fraction of employment or land use by process category for subcounty areas.

3.4.2.2 Data Requirements

1. Same as for industrial process emissions, except all power generation facilities and major municipal incineration facilities should be interviewed for expansion plans and included in the point source forecasts.
2. Employment (or land use) for existing industrial point sources and total subarea industrial employment (or land use) must be known for Order 1.

3.4.2.3 Procedural Overview

Figure 3.4-2 diagrams the sequence of table use for allocating fuel combustion emissions for each of the three allocation orders. The procedure for industrial fuel combustion emissions allocation is essentially the same as that for industrial process emission. Order 1 assumes that all growth is at existing (or identifiable) point source locations. The addition of the baseline countywide area fuel combustion source term requires that employment (or land use) for existing sources and total industrial subarea employment (or land use) be known for Order 1 to allocate these emissions to subareas. Order 2 and Order 3 procedures are similar to those for industrial process emission except for computational differences.

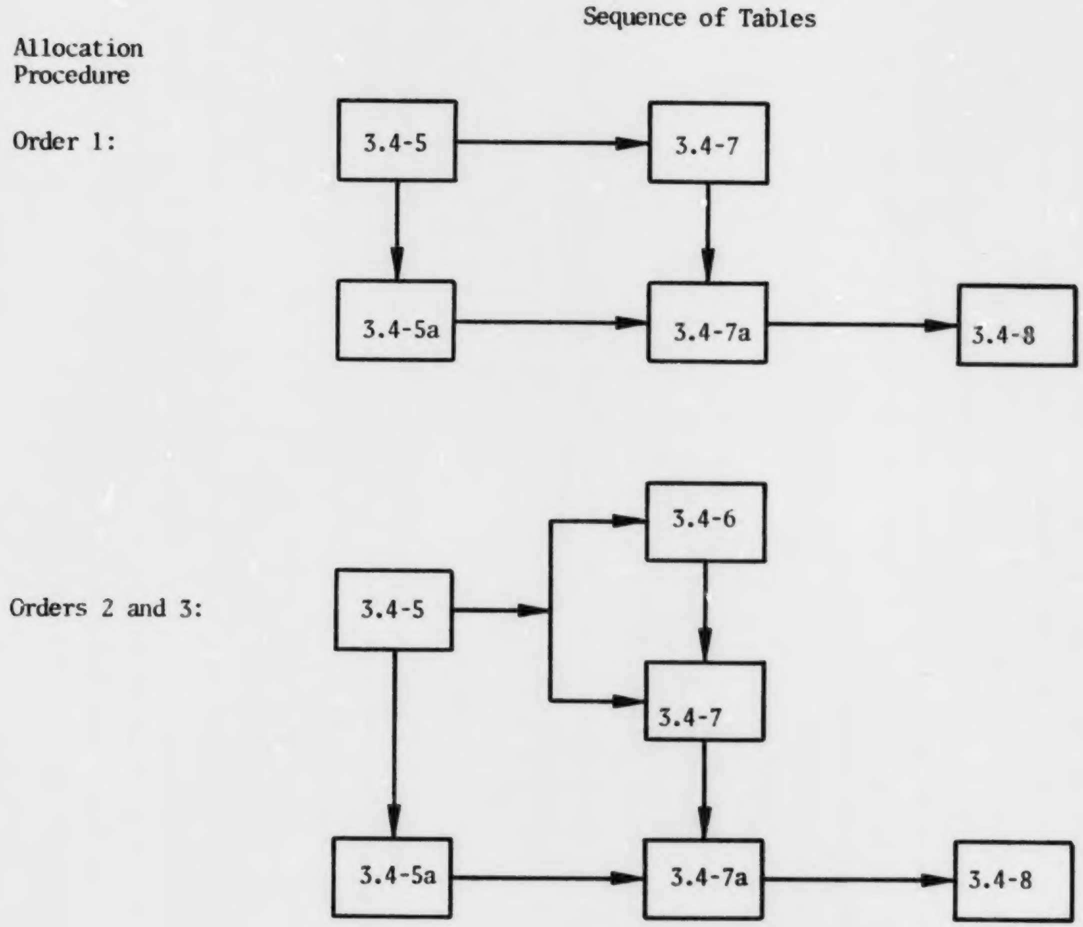
Sequence of Tables
Allocation Procedure
Order 1:
3.4-5
3.4-7
3.4-5a
3.4-7a
3.4-8
Orders 2 and 3:
3.4-5
3.4-6
3.4-7
3.4-5a
3.4-7a
3.4-8

Figure 3.4-2 Industrial Fuel Combustion Allocation Table Sequence

Table 3.4-5

Industrial Point Source Fuel Use

A. County ____________

B. Year ____________

C. Allocation Order ____________

(1) Industrial Process Category	Source Identification					Fuel Demand and Fuel Use Forecast																		
	(2) Name	(3) Process	(4) Subarea	(5) Coord.		(6) GF**	(7) MBTU	(8) Emp.*	(9) COAL	(10) %S	(11) %A	(12) R OIL	(13) %S	(14) D OIL	(15) %S	(16) NG	(17) P GAS	(18) LPG	(19) COKE	(20) WOOD	(21) B-ASSE	(22) DIES	(23) GAS	
				X	Y																			

*Employment
**Growth Factor

Table 3.4-5a (Cont. of 3.4-5)

Industrial Point Source Fuel Combustion Emissions

A. County ________________
B. Year ________________
C. Allocation Order 1, 2, and 3

(1) Industrial Process Category	Source Identification					Fuel Combustion Emissions Forecast (tons/yr)									
	(2) Name	(3) Process	(4) Subarea	(5) Coord.		(6) Part.		(7) SO_x		(8) CO		(9) HC		(10) NO_x	
				X	Y	Cont.	Emis.	Cont.	Emis.	Cont.	Emis.	Cont.	Emis.	Cont.	Emis.

Table 3.4-6

Industrial Point and New Source Energy Demand by Process Category

A. County ____________
B. Year ____________
C. Allocation Order 2 and 3

Industrial Process Category	Baseline Year Existing Point Sources		Forecast Year - All Sources			Forecast Year Existing Point Sources		Forecast Year New Sources	
(1)	(2) MBTU	(3) Emp.*	(4) GF**	(5) MBTU	(6) Emp.*	(7) MBTU	(8) Emp.*	(9) MBTU	(10) Emp.*
Power Generation								▨	▨
Industrial Area						▨	▨		
D. COUNTY TOTAL			▨						

*Employment
**Growth Factor

Table 3.4-7

Industrial New Source Fuel Use By Process Category and Subarea

A. County ____________
B. Subarea ____________
C. Year ____________
D. Allocation Order ____________

Industrial Process Category (1)	Total Emp.* (2)	Point Source Emp.* (3)	New Source Emp.* (4)	EAP** (5)	Fuel Demand and Fuel Use Forecast																
					(6) MMTH	(7) COAL	(8) %S	(9) %A	(10) R OIL	(11) %S	(12) D OIL	(13) %S	(14) NG	(15) P GAS	(16) LPG	(17) COKE	(18) WOOD	(19) B-ASSE	(20) DILS	(21) GAS	
Power Generation																					
Industrial Area																					
SUBAREA TOTAL																					

*Employment

**Employment Allocation Proportion = $\frac{\text{Subarea Category New Source Employment}}{\text{Total Category New Source Employment}}$. This value may be obtained from Table 3.4-3.

Table 3.4-7a (Cont. of 3.4-7)

Industrial New Source Fuel Combustion Emissions by Process Category and Subarea

A. County __________
B. Subarea __________
C. Year __________
D. Allocation Order 1*, 2, and 3

(1) Industrial Process Category	New Source Emissions (tons/yr)									
	(2) Part.		(3) SO_x		(4) CO		(5) HC		(6) NO_x	
	Controls	Emissions	Controls	Emissions	Controls	Emissions	Controls	Emissions	Controls	Emissions
Power Generation										
Industrial Area										
E. COUNTY TOTAL										

*When following an Order 1 allocation procedure, only the "Industrial Area" row of this table will be used.

Table 3.4-8

Industrial Point and New Source Fuel Combustion Emissions - Subarea Summary

A. County ______
B. Subarea ______
C. Year ______
D. Allocation Order 1, 2, and 3

Subarea	Point Source Emissions							New Source Emissions						Total Emissions					
(1)	(2) No. of Sources	(3) Emp.*	(4) Part.	(5) SO_x	(6) CO	(7) HC	(8) NO_x	(9) Emp.*	(10) Part.	(11) SO_x	(12) CO	(13) HC	(14) NO_x	(15) Emp.*	(16) Part.	(17) SO_x	(18) CO	(19) HC	(20) NO_x

*Employment

3.4.2.4 Order 1 Allocations

Industrial Point Source Fuel Use: Table 3.4-5

Column heading definitions for Table 3.4-5 are as follows:

Symbol	Definition
MBTU	10^3 Btu
COAL	Coal use (tons)
% S	Percent sulfur content by weight
% A	Percent ash content by weight
R OIL	Residual Oil (10^3 gal)
D OIL	Distillate Oil (10^3 gal)
NG	Natural Gas (10^6 cu ft)
P GAS	Process Gas (10^6 cu ft)
LPG	Liquid Propane Gas (10^3 gal)
COKE	Coke (tons)
WOOD	Wood (tons)
B-ASSE	Bagasse (tons)
DIES	Diesel (10^3 gal)
GAS	Gasoline (10^3 gal)

1. Enter descriptive information in columns (1)-(5) as described for Industrial Point Source Process Emissions, Table 3.4-1.
2. Enter the applicable growth factors in column (6) for the forecast year by SCC process or by process category if the former are not available (this growth factor is 1.0 for the baseline year.)
3. Calculate the total fuel demand for the forecast year as the product of the baseline fuel demand and the growth factor and enter in column (7).
4. Calculate the growth in employment (or land use) as the product of the baseline employment and the growth factor and enter the result in column (8).
5. Distribute fuel use in the forecast year assuming the same fuel mix as in the baseline year or change in mix stratified by regional study. Record the sulfur and ash contents taking account of control regulations in the forecast years. Enter these data in columns (9)-(23).
6. Sum over all sources in each category and record totals on the line at the bottom of each category sheet for each forecast year.

Industrial Point Source Fuel Combustion Emissions: Table 3.4-5a (continuation of Table 3.4-5)

1. Estimate the proportional reduction in emissions of each pollutant due to control regulations relative to baseline year for each process category and record 1.0 minus this proportional reduction in emissions in the left-hand side of columns (6)-(10). Compute forecast year emissions as the product of fuel consumption (from Table 3.4-5), appropriate fuel use emission factors obtained from the USEPA publication Compilation of Air Pollutant Emission Factors (AP-42) and control reduction factor and record in the right-hand side of columns (6)-(10).

2. Sum and record total fuel combustion emissions for each process category.

   NOTE: In addition to the major industrial categories, Tables 3.4-5 and 3.4-5a should be filled out for all power generation facilities, major municipal incineration facilities, and the countywide industrial area source, category hereafter labeled Industrial Area. The industrial area source growth factor can be estimated as the average growth rate for the industrial sector as a whole if no other information is available. Baseline industrial area source employment (or land use) has been subtracted from the county total industrial employment (or land use) to get point source growth estimates.

Industrial New Source Fuel Use by Process Category and Subarea: Table 3.4-7

In the Order 1 analysis, only the growth in Industrial Area category is allocated to subareas since all of the remaining industrial growth is assumed to be at existing point source locations.

1. Fill in the descriptive information at the top of the table (items A through D). Note that a separate table will be filled out for each subcounty area.

2. In column (1) enter the process category identification (SIC, SCC, etc.) of processes considered in Table 3.4-5.

3. At the bottom of column (2) enter the total subarea industrial employment (or land use) as determined from area planning studies.

4. In column (3) enter the existing point source process category employment (or land use) by identifying sources located in the subarea from Table 3.4-5. Sum to obtain total point source subarea employment and record at bottom of column (3).

5. Obtain subarea Industrial Area employment (or land use) by subtracting total subarea industrial point source employment (bottom of column (3)) from total subarea industrial employment (bottom of column (2)) and enter opposite Industrial Area in column (4) as new source employment. (If negative, enter as zero.)

6. Divide Industrial Area new source employment (or land use) by total county projected Industrial Area employment (Table 3.4-5) to obtain employment allocation proportion (EAP). Enter EAP value to column (5) opposite Industrial Area.

7. Compute the subarea Industrial Area fuel demand as the product of the EAP and the countywide fuel demand of Table 3.4-5 and record opposite Industrial Area in column (6).

8. Fill in remainder of table (columns (7)-(21)) opposite Industrial Area by assuming some fuel mix as countywide industrial fuel combustion and source. Record sulfur and ash contents taking account of control regulations in forecast years.

Industrial New Source Fuel Combustion Emissions by Process Category and Subarea: Table 3.4-7a (continuation of Table 3.4-7)

Only the category Industrial Area is required in Order 1 analyses for Table 3.4-7a.

1. Enter the descriptive information at the top of the table (items A through D).

2. Enter the estimated control reduction factor (1.0 minus the estimated proportional reduction in emissions attributable to pollution control regulations), relative to baseline year, opposite Industrial Area in the left-hand side of columns (2)-(6). Compute the subarea forecast year Industrial Area fuel combustion emissions as the product of fuel consumption (from Table 3.4-7), appropriate fuel use emission factors, and control reduction factors. Enter the results in the right-hand side of columns (2)-(6).

Industrial Point and New Source Fuel Combustion Emissions - Subarea Summary: Table 3.4-8

Table 3.4-8 provides a summary of emissions (in this case point sources and Industrial Area) by subarea. Record the sum of appropriate point source fuel combustion emissions by subarea determined from Table 3.4-5a and the Industrial Area fuel combustion emissions in columns (2)-(6) from Table 3.4-7a, and sum over all subareas to obtain countywide totals.

3.4.2.5 Order 2 Allocations

Industrial Point Source Fuel Use: Table 3.4-5

1. Fill in according to Order 1 procedures. For forecast years, use the estimated growth factor for existing sources.

Industrial Point and New Source Energy Demand by Process Category: Table 3.4-6

1. Fill in the descriptive information at the top of the table (items A through C).
2. In column (1) enter the process category identification (SIC, SCC, etc.) for which growth factors are greater than 1.0.
3. In column (2) enter the energy demand and in column (3) the employment (or land use) for each process category for the baseline year. This information is obtained by summing the energy demand and employment over all individual sources in each process category from Table 3.4-5.
4. Enter the total growth factor for each process category in column (4).
5. Compute the forecast year energy demand and employment (or land use) for all sources in each process category by multiplying the baseline year energy demand and employment (or land use) by the growth factor. Enter the results in columns (5) and (6). (Employment or land use projections may also be available from area planning studies.)
6. Record the total process category growth in energy demand and employment (or land use) at existing sources from Table 3.4-5 in columns (8) and (9) for the appropriate process year.
7. Compute the forecast year new source energy demand for each process category by subtracting column (7) from column (5) and record in column (9). If any of the computations are negative, record a zero in the column.
8. Compute the forecast year new source employment (or land use) as the difference between columns (6) and (8) and enter in column (10).
9. Repeat steps 1-8 for each forecast year.

Industrial New Source Fuel Use by Process Category and Subarea: Table 3.4-7

1. Fill in the descriptive information at the top of the table (items A through D).

2. In column (1) enter the process category identification (SIC, SCC, etc.) from column (1) of Table 3.4-6.

3. In column (2) enter the total process category employment (or land use) in the subarea as determined from area planning studies.

4. In column (3) enter existing point source process category employment (or land use) by identifying sources located in the subarea from Table 3.4-5. Record zero employment opposite Industrial Area.

5. Compute new source process category employment (or land use) as the difference between columns (2) and (3) and enter in column (4). Record zero if the result is negative.

6. Compute the new source process category employment (or land use) allocation proportion (EAP) as the ratio of the values in column (4) to the county total new source process category employment in column (10) of Table 3.4-6. Enter the results in column (5).

7. Compute the new source energy demand in the subarea by multiplying the total process category new source energy demand from column (9) of Table 3.4-6 by the EAP of column (5). Enter the results in column (6).

8. Fill in the remainder of the table (columns (7)-(23)) by supplying a forecast of fuel use distribution for each process category and subarea or by assuming the same fuel use distribution as in the baseline year. Record sulfur and ash content taking account of control regulations in the forecast year.

Industrial New Source Fuel Combinations Emissions by Process Category and Subarea: Table 3.4-7a (continuation of Table 3.4-7)

1. Fill in the descriptive information at the top of the table (items A through D).

2. Enter the estimated proportional reduction in emissions of each pollutant due to control regulations relative to the baseline year for each process category and record 1.0 minus this proportional reduction in emissions in the left-hand side of columns (2)-(6). Compute the subarea forecast year new source fuel combustion emissions as the product of fuel combustion (from Table 3.4-7), appropriate fuel use emission factors, and control reduction factors, and enter the results in the right-hand side of columns (2)-(6).

Industrial Point and New Source Fuel Combustion Emissions - Subarea Summary: Table 3.4-8

1. In each subarea, record existing point source fuel combustion emissions and new source subarea fuel combustion emissions, and sum to yield subarea totals.
2. Sum over subareas to yield county totals and check these with the totals in Table 3.4-6.

3.4.2.6 Order 3 Allocations

Order 3 procedures follow the same general format as Order 2 procedures, except that point source field interview data is used in the analysis to estimate the fraction of growth in existing sources. The remaining growth is allocated to new sources following the Order 2 employment (or land use) based allocation procedures.

Industrial Point Source Fuel Use: Table 3.4-5

1. Fill in following Order 1 procedures. Note that if the plant survey gives an indication of new point source locations, these should be included in the appropriate tables.

Industrial Point Source Fuel Combustion Emissions: Table 3.4-5a

1. Fill in according to Order 1 procedures.

Industrial Point and New Source Energy Demand by Process Category: Table 3.4-6

1. Fill in according to steps 1-5 of Order 2 procedures.
2. Columns (7) and (8) are filled in using data for the appropriate year from Table 3.4-5. These columns now represent increased fuel demands at existing and new point sources. This information is obtained from the plant survey.
3. Continue with remainder of Order 2 procedures.

Industrial New Source Fuel Use by Process Category and Subarea: Table 3.4-7

1. Fill in according to Order 2 procedures.

Industrial New Source Fuel Combustion Emissions by Process Category and Subarea: Table 3.4-7a

1. Fill in according to Order 2 procedures.

Industrial Point and Area Source Fuel Combustion Emissions - Subarea Summary: Table 3.4-8

1. Fill in according to Order 2 procedures.

3.5 SOLID WASTE DISPOSAL

3.5.1 Introduction

Emissions resulting from the incineration of solid waste can be traced to three major types of area sources: residential, commercial/institutional and industrial. The three Orders of increasingly more detailed allocation procedures rely on population and/or employment distributions, depending upon the type of source being considered. The techniques described in this section will depend upon which of the subcounty population or commercial/institutional-industrial data bases described in Section 2 are chosen. Only solid waste that is disposed of by on-site incineration and open burning will be considered. Solid waste incinerated in a municipal incinerator is assumed to be included in the point source data. Landfill is not considered as an emission source.

3.5.2 Data Requirements

Data required for allocating incineration emissions from each type of source using each of the three Orders are as follows:

Order 1:

a. Actual and projected population and/or employment for each specified subcounty area. (Sources: U.S. Census of Population; or state, regional and local planning agencies.)

b. Estimated county totals (actual and projected) of solid waste disposed by on-site incineration and open burning. (Source: Analysis from Projecting County Emissions: Volume 7.)

Order 2:

a. Actual and projected populations and/or employment for each specified subcounty area. (Sources: same as Order 1.)

b. County totals (actual and projected) of solid waste disposed of by on-site incineration and open burning. (Sources: survey of county solid waste and land use studies, analysis from Projecting County Emissions: Volume 7.)

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Order 3:

a. Actual and projected population and/or employment for each specified subcounty area. (Sources: same as for Orders 1 and 2.)

b. County totals (actual and projected) of solid waste disposed of by on-site incineration and open burning. (Sources: survey of county solid waste and land use studies and interviews with county and local officials, analysis from Projecting County Emissions: Volume 7.)

3.5.3 Procedural Overview

Figure 3.5-1 diagrams the sequence in which the tables are to be used for allocating emissions from solid waste. Because the allocation of emissions from solid waste incineration involves three types of area sources, all three orders of computation draw from previous sections dealing with residential (Section 3.1), commercial/institutional (Section 3.3) and industrial (Section 3.4) emissions. In each instance the population and employment distributions used to allocate these emissions are developed using tables the mechanics of which have already been detailed.

Order 1 procedures rely on the allocation of solid waste quantities by population distribution for residential and commercial/institutional sources and by employment for industrial sources. Order 2 differs in that the commercial/institutional solid waste is allocated by employment. In Order 3 reliance is placed on planning studies and interviews to determine solid waste quantities in each subarea.

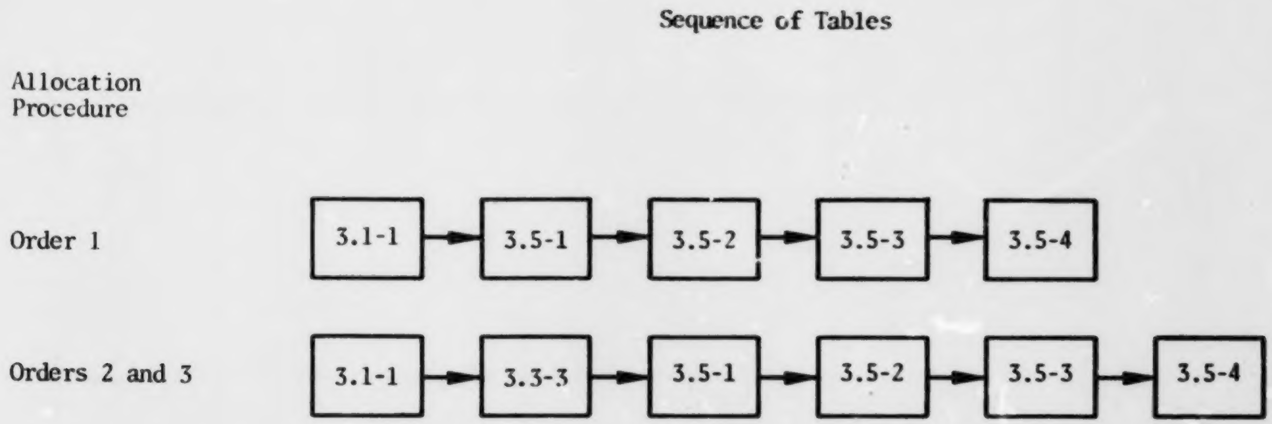
Sequence of Tables
Allocation Procedure
Order 1
3.1-1
3.5-1
3.5-2
3.5-3
3.5-4
Orders 2 and 3
3.1-1
3.3-3
3.5-1
3.5-2
3.5-3
3.5-4

Figure 3.5-1 Solid Waste Disposal Allocation Sequence

Table 3.5-1

Manufacturing Employment-Based Allocation Proportions for Subcounty Areas

A. County ____________________
B. Year ____________________
C. Allocation Order 1,2 and 3

(1) Subareas	(2) Manufacturing Employment	(3) Allocation Proportion
SUBAREA TOTAL		
Residual		
D. COUNTY TOTAL		1.0

Table 3.5-2

Annual Solid Waste Incineration

A. County ____________________
B. Year ______________________
C. Allocation Order 1, 2 and 3

(1) Subareas	Annual Solid Waste Incineration by Source (Tons/yr)					
	Residential		Commercial/Institutional		Industrial	
	(2) On-Site Incin.	(3) Open Burning	(4) On-Site Incin.	(5) Open Burning	(6) On-Site Incin.	(7) Open Burning
SUBAREA TOTAL						
Residual						
D. COUNTY TOTAL						

Table 3.5-3

Solid Waste Incineration Emission Factors

(1)		Emission Factors				
		(2) Part.	(3) SO_x	(4) CO	(5) HC	(6) NO_x
Residential	On-Site Incineration					
	Open Burning					
Commercial/ Institutional	On-Site Incineration					
	Open Burning					
Industrial	On-Site Incineration					
	Open Burning					

Table 3.5-4

Solid Waste Incineration Emissions Allocated to Subcounty Areas

A. County ____________________
B. Year ____________________
C. Allocation Order 1, 2 and 3

	Emissions (tons/yr)				
(1) Sub-areas	(2) Part.	(3) SO_x	(4) CO	(5) HC	(6) NO_x
SUBAREA TOTAL					
Residual					
D. COUNTY TOTAL					

3.5.4 Order 1 Allocations

The least detailed procedure for allocating emissions from the burning of solid waste relies upon distributions of the population and manufacturing employment. County totals for the amount of material disposed of through on-site incineration and open burning are first computed for three types of area sources; residential, commercial/institutional and industrial. Residential and commercial/institutional emissions are allocated to subcounty areas on the basis of population distributions. Emissions from industrial area source solid waste disposal are allocated according to the distribution of manufacturing employment.

Population-based Allocation Proportions: Table 3.1-1

1. Fill in as described under the Order 1 analysis for residential fuel combustion emissions (Section 3.1) if not already completed.

Manufacturing Employment-based Allocation Proportions: Table 3.5-1

1. Fill in the descriptive information at the top of the table (items A through C).
2. Fill in the subcounty area designations in column (1) consistent with Table 3.1-1.
3. In column (2) enter the manufacturing employment (or land use) in each subarea and in the Residual. The number of manufacturing employees can be copied from the SUBAREA TOTAL row of Table 3.4-3 for each subcounty area.
4. Compute the employment allocation proportion and enter into column (3) by dividing the subarea employment by the COUNTY TOTAL in row D. The total number of manufacturing employees to be entered in row D can be copied directly from the COUNTY TOTAL row of column (14) Table 3.4-2. (Refer to Table 3.1-1 for analogous detailed instructions in generating these employment allocation proportions.)

Annual Solid Waste Incineration: Table 3.5-2

1. Fill in the descriptive information at the top of the table (items A through C).
2. Fill in the subcounty area designations in column (1).

3. In the COUNTY TOTAL row (row D) enter the solid waste totals for on-site incineration and open burning from each source category in columns (2)-(7). Obtain this information from the analysis carried out per Projecting County Emissions: Volume 7.

4. Handling each subcounty area, the TOTAL, and Residual separately, allocate the total amount of solid waste disposed of in the county by each burning method in the following way.

   a. Residential and commercial/institutional solid waste.

      Multiply the population allocation proportion from column (3), Table 3.1-1, by the total amount of solid waste disposed of through on-site incineration and open burning. Enter the resulting amounts in columns (2)-(3).

   b. Industrial solid waste

      Multiply the manufacturing employment allocation proportion from column (3), Table 3.5-1, by the total amount of solid waste disposed of through on-site incineration and open burning. Enter the resulting amounts in columns (6) and (7).

Solid Waste Incineration Emission Factors: Table 3.5-3

1. Examine Table 3.5-3. Column (1) specifies incineration methods for different sources used to dispose of solid waste. Columns (2) through (6) indicate the five pollutants for which emissions will be allocated to the various subcounty areas.

2. For each type of burning, locate the appropriate emission factor from Compilation of Air Pollutant Emission Factors (AP-42). Enter this value in the appropriate cell.

Allocated Solid Waste Incineration Emissions: Table 3.5-4

1. Fill in the descriptive information at the top of the table (items A through C).

2. For each source and burning method, multiply the solid waste quantity in Table 3.5-2 columns (2)-(7) by the appropriate emission factor of Table 3.5-3 and enter the summation in the corresponding cell of this table.

3.5.5 Order 2 Allocations

In using an Order 2 analysis, amounts of burned refuse to be attributed to residential, commercial/institutional and industrial area sources are obtained from local solid waste studies using higher level analyses as in

Projecting County Emissions: Volume 7. Residential solid waste quantities are allocated to subcounty areas according to population distribution. Commercial/institutional, and industrial solid waste quantities are allocated on the basis of respective employment distributions.

Population-based Allocation Proportions: Table 3.1-1

1. Fill in as described under the Order 1 analysis for residential fuel combustion emissions (Section 3.1) if not already completed.

Commercial/Institutional Employment-based Allocation Proportions: Table 3.3-3

1. Fill in as described under the Order 2 analysis for commercial/institutional fuel combustion emissions (Section 3.3) if not already completed.

Manufacturing Employment-based Allocation Proportions: Table 3.5-1

1. Fill in as described under the Order 1 Allocations of this section.

Annual Solid Waste Incineration: Table 3.5-2

1. Fill in as described in steps 1-3 under Order 1 Allocations of this section.

   NOTE: When proceeding to step 4a allocate the residential solid waste by the population allocation proportion of Table 3.1-1 and the commercial/institutional solid waste by the employment allocation proportion of Table 3.3-3.

Solid Waste Incineration Emission Factors: Table 3.5-3

1. Fill in as described under Order 1 Allocations of this section.

Allocated Solid Waste Incineration Emissions: Table 3.5-4

1. Fill in as described under Order 1 Allocations of this section.

3.5.6 Order 3 Allocations

Order 3 provides the most extensive procedures for allocating emissions from the incineration of solid waste because it requires surveying local solid waste studies and interviewing local officials. Existing and projected solid waste quantities obtained from these sources of information should allow the user to determine directly the quantities of solid waste incinerated in each subarea. The choice of municipalities as a subcounty area set for this allocation procedure may facilitate the computations since the data will most likely be on a municipality basis.

Population-based Allocation Proportions: Table 3.1-1

1. Fill in as described under the Order 1 analysis for residential fuel combustion emissions (Section 3.1) if not already completed.

Commercial/Institutional Employment-based Allocation Proportions: Table 3.3-3

1. Fill in as described under the Order 2 analysis for commercial/institutional fuel combustion emissions (Section 3.3) if not already completed.

Manufacturing Employment-based Allocation Proportions: Table 3.5-1

1. Fill in as described under the Order 1 Allocations of this section.

Annual Solid Waste Incineration: Table 3.5-2

1. Fill in the descriptive information at the top of the table (items A through C).
2. Fill in the subcounty area designations in column (1).
3. For each subarea, the Residual, and the COUNTY TOTAL, enter the quantity of solid waste burned by each incineration method from the solid waste studies. Do this for each source category.

Solid Waste Incineration Emission Factors: Table 3.5-3

1. Fill in as described under Order 1 Allocations of this section.

Allocated Solid Waste Incineration Emissions: Table 3.5-4

1. Fill in as described in steps 1 and 2 under Order 1 allocations of this section.

3.6 MISCELLANEOUS SOURCES

3.6.1 Introduction

This category is designed to serve as a catchall for sources not covered in the previous emission source groupings. As such, the sources are likely to be specialized and uniquely defined in terms of their emission characteristics. Examples of the types of sources included here are fugitive dust sources, forest fires and slash burning, and agricultural frost control. Also, this category can conceivably include a multitude of different types of sources, which makes the delineation of a generalized methodology very difficult. Nevertheless, for the sake of providing some structural format for the allocation of these emissions to subcounty areas two procedures will be outlined: one for sources which are distributed more or less throughout the whole country, one for sources located only in specific areas. Only one allocation Order will be prescribed.

3.6.2 Data Requirements

The data required for each source includes the pollutant emission rate, a distribution of source activity throughout the county (if it is widely distributed), and the specific location(s) of the source (if it is only in a few areas).

3.6.3 Procedural Overview

For widely distributed sources the allocation procedure is to define a distribution of source activity throughout the county and allocate the emissions accordingly. This distribution may be one of the previously used functions (e.g, population, employment, land use, etc.) or may be some other parameter determined to be more relevant. Likewise, the subcounty area set may be one already used or an entirely new one.

Sources located in specific areas only may be treated in the same fashion as are airports and railroad yards, for example. A square is drawn around the source location and is identified by the coordinates of its lower left-hand corner and the length of a side. More than one square can be used if necessary.

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Table 3.6-1

Distributed Miscellaneous Source Emissions

A. County ____________
B. Year ____________

(1) Subcounty Area	(2) Activity Proportion	Emissions (tons/yr)				
		(3) Part.	(4) SO_x	(5) CO	(6) HC	(7) NO_x
SUBAREA TOTAL						
Residual						
C. COUNTY TOTAL						

Table 3.6-2

Isolated Miscellaneous Source Emissions

A. County ________
B. Year ________

Source Coordinates (1)		Length of Square (2)	Emissions (tons/yr)				
X	Y		(3) Part.	(4) SO_x	(5) CO	(6) HC	(7) NO_x

3.6.4 Allocation Procedures for Distributed Miscellaneous Sources

This procedure uses Table 3.6-1 to record the emissions. The subcounty areas used and the activity proportions may be drawn from previously completed tables if desired.

Distributed Miscellaneous Source Emissions: Table 3.6-1

1. Fill in the descriptive information at the top of the tables (items A through B).
2. In column (1) enter the chosen subcounty area designations. In columns (3) through (7) of the COUNTY TOTAL row (row C) enter the countywide emissions from the source as computed by the analysis per Projecting County Emissions: Volume 7.
3. In column (2) enter the chosen activity proportion (population, employment, land use, etc.).
4. Multiply the emissions in row C by the activity proportion of column (2) for each subcounty area and the Residual and enter into columns (3) through (7).
5. Fill out a separate table for each miscellaneous source.

3.6.5 Allocation Procedures for Isolated Miscellaneous Sources

This procedure uses Table 3.6-2 to record the emissions. The first step is to locate the sources by drawing a square (or several squares if necessary) around the source. Emissions are then treated as coming from this area source.

Isolated Miscellaneous Source Emissions: Table 3.6-2

1. Fill in the descriptive information at the top of the table (items A and B).
2. For the square(s) surrounding each source enter the coordinates of the lower left-hand corner and the length of the square in columns (1) and (2), respectively.
3. Enter the source emissions in columns (3) through (7).

4.0 MASTER GRIDDING

To this point each of the stages of the allocation procedure have been handled separately: population, transportation, commercial/institutional-industrial, and miscellaneous. It is entirely conceivable that at this point the emissions from each source category have been allocated to a separate set of subcounty areas each distinct from the other. From the standpoint of dispersion modeling, there is no conceptual problem in this since each of the subareas in each of the sets can be treated as an individual source. There is no problem with geographically overlapping sources and the only constraint on conducting the modeling with a multitude of subareas is that the required computer time and storage space can become excessive.

From the standpoint of air quality maintenance regulations, the overlapping subareas may confuse the picture as to where control strategies should be implemented. This is not an insurmountable problem and there are some advantages to keeping the emission source allocations in separate subarea sets.

Notwithstanding the lack of any major problems in keeping the subcounty areas separate, it is recommended that a single master grid system be developed on which to coordinate the results from all the previous analyses. Some additional effort will be required to develop the grid but will result in bypassing the aforementioned problems.

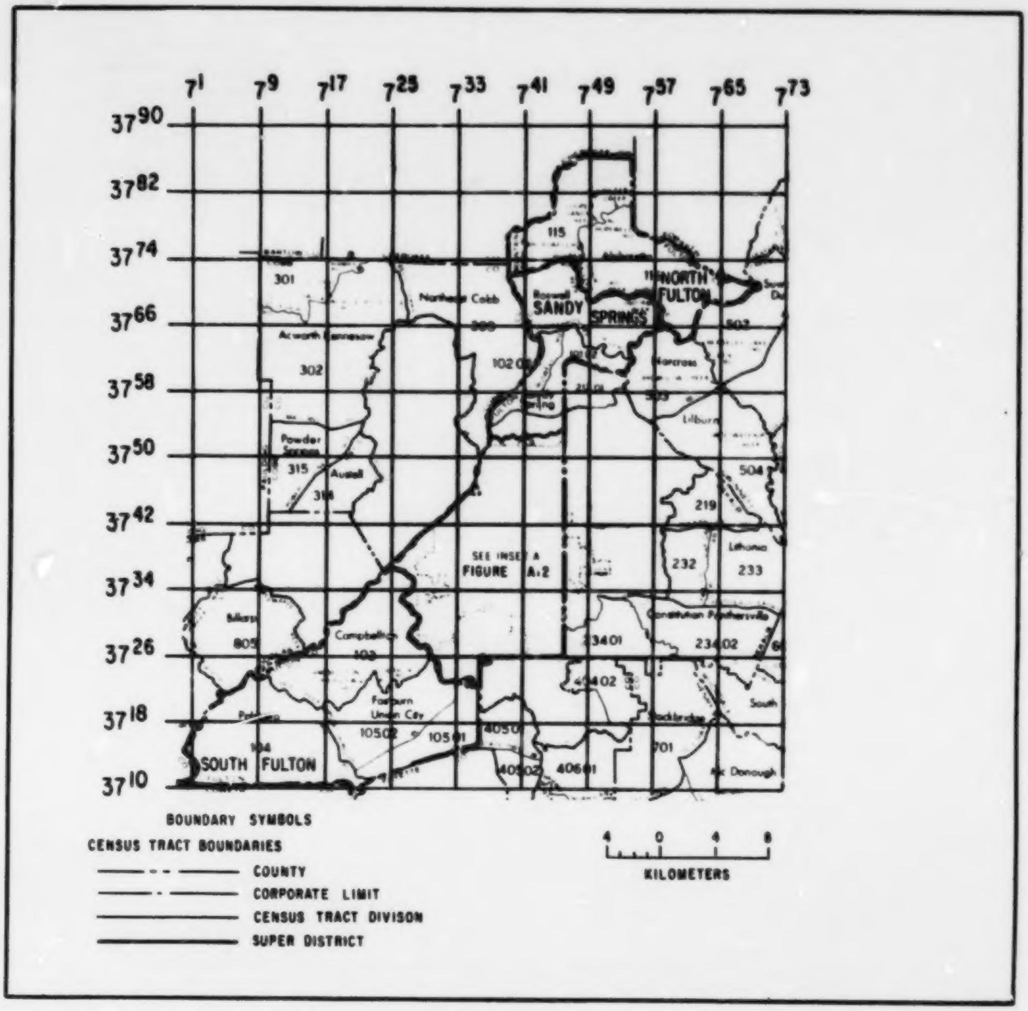
The grid system that is developed need not be based on a rectangular coordinate system and any of the previously defined subcounty area sets could serve as the master grid. For the sake of generality, however, the procedure for developing a rectangular master grid will be developed here.

It is recommended that the Universal Transverse Mercator (UTM) coordinate system be used as the basis for the master grid because of its wide application throughout the country. The individual grid squares will vary in size depending on the resolution of the individual subcounty area sets. The smallest grid square chosen should be 1 km x 1 km. Smaller grids would result in a resolution that in all probability does not exist in the original data set. In addition, air pollutant dispersion models that will require grids of integer length are being designed by the EPA. The largest grid square chosen should be 8 km x 8 km. Larger grids would probably cancel some of the subcounty allocation resolution achieved by the previous analyses. In addition, the 8 x 8 structure allows an integer subdivision of grids down to the 1 x 1 grid. Figures 4.1-1 and 4.1-2 illustrate typical grid overlays.

The following steps are designed to describe the step-by-step details of master gridding.

Master Gridding Procedure: Tables 4-1 and 4-2

1. On a sheet of transparent plastic (e.g. Mylar) draw a square grid system using the largest grid chosen (e.g., 8 km x 8 km). Use the same scale as the map of the population-based subcounty areas used in Section 3-1.
2. Overlay this sheet onto the map of the population-based subcounty areas and line up the grid squares with the coordinate system (preferably UTM).
3. Going over the entire map, subdivide the grid squares wherever there are a number of subcounty areas within a single grid. Subdivide until the smallest chosen grid size is reached or until the subdivision contains only one subcounty area (see Figures 4.1-1 and 4.1-2).
4. Remove the grid system from the population-based subcounty area set and lay it over the transportation subcounty area set (if different from the population set). Perform additional subdivision of the grid where necessary using the same criteria as for the population subcounty area set.
5. Repeat the procedure for the commercial/institutional-industrial subcounty area set and the miscellaneous subcounty area set.
6. Take the fully subdivided grid and replace it over the population subarea set.
7. In column (1) of Table 4-1 enter the designation of the first master grid square. In column (2) enter the designation of all the subcounty areas which fall into the master grid square.
8. Map the subcounty areas onto the master grid by estimating the fraction of subcounty area in the master grid square and enter this fraction in column (3) of Table 4.1 (The assumption is made that the emissions are uniformly distributed over each subcounty area; therefore, the emissions can be apportioned to the master grid square on the basis of area.) The estimate can be made using a visual judgment, a planimeter, or other procedure. For most applications the visual judgment will probably be inadequate. (This step may indicate the need to refine the Master Grid to aid precision.)


7^{1}
7^{9}
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7^{57}
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7^{73}
37^{90}
37^{82}
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37^{58}
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37^{42}
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37^{26}
37^{18}
37^{10}
115
301
Northeast Cobb
Roswell
SANDY
SPRINGS
NORTH
FULTON
Acworth Kennesaw
302
102 01
Norcross
Lilburn
Powder Springs
315
Austell
316
504
219
SEE INSET A
FIGURE A.2
232
Lithonia
233
Campbellton
103
Conyers
805
23401
23402
40402
Fairburn
Union City
South
Stockbridge
10502
10501
40501
104
SOUTH FULTON
40502
40601
701
Mc Donough
BOUNDARY SYMBOLS
CENSUS TRACT BOUNDARIES
COUNTY
CORPORATE LIMIT
CENSUS TRACT DIVISON
SUPER DISTRICT
4
0
4
8
KILOMETERS

Figure 4.1-1 Master Grid Overlay

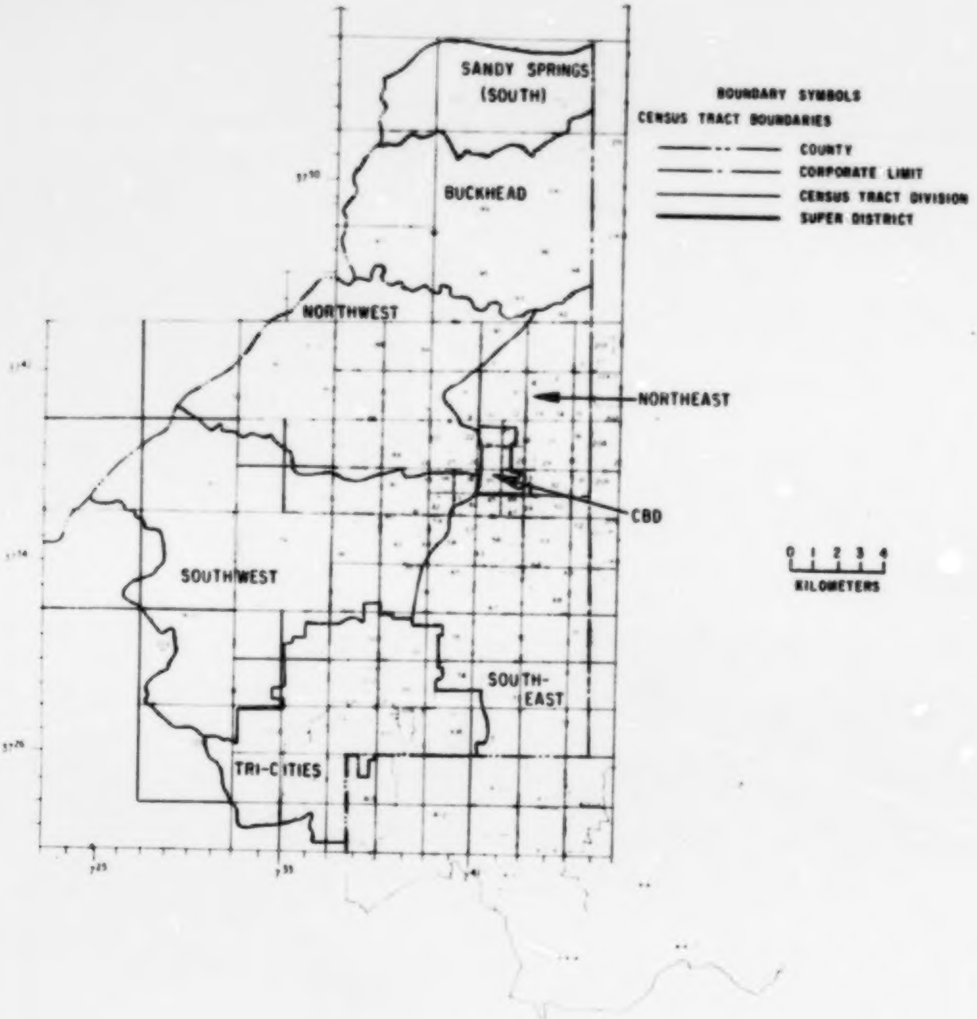
SANDY SPRINGS (SOUTH)
BUCKHEAD
NORTHWEST
NORTHEAST
CBD
SOUTHWEST
SOUTH-EAST
TRI-CITIES
BOUNDARY SYMBOLS
CENSUS TRACT BOUNDARIES
COUNTY
CORPORATE LIMIT
CENSUS TRACT DIVISION
SUPER DISTRICT
0 1 2 3 4
KILOMETERS

Figure 4 1 2 Master Grid Overlay: Insert

9. Repeat the procedure for the transportation, commercial/institutional-industrial, and miscellaneous subcounty area sets.

10. Starting with the first master grid square, compute its emissions by multiplying the emissions from each subcounty area contained in the master grid by the fraction of that subarea that is in the master grid and enter the result in Table 4-2. Repeat for all master grid squares.

11. At this point air quality dispersion modeling can be performed using the master grids as area sources, the commercial/institutional-industrial point sources, and the limited access highway line sources. Alternatively the line sources and point sources can be assigned to the master grid squares in which they are located.

This completes the allocation of emissions from county to subcounty areas. The user is referred to other volumes in this series for the remainder of the air quality maintenance planning procedures.

Table 4.1

Master Grid Mapping

A. County ____________________
B. Subcounty Area Set __________

(1) Master Grid Designation	(2) Subcounty Area Designation	(3) Fraction of Subcounty Area in Master Grid

Table 4.2

Master Grid Emissions

A. County ___________
B. Year ___________

	Emissions (tons/yr)				
(1) Master Grid Designation	(2) Part.	(3) SO_x	(4) CO	(5) HC	(6) NO_x

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We also extend thanks to the many EES staff members who made significant contributions to this project. Mr. Michael L. Wilkey supervised the Fulton County test case of the methodology. Messrs. Walter W. Clapper and Robert J. Neisius drafted all of the graphics and Ms. Marjorie A. Brockman typed the final manuscript. Ms. Olga Skala read many versions of the manuscript and made innumerable contributions to its final form.

While all of the above were very helpful throughout the project, the authors alone are accountable for any of its deficiencies.

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APPENDIX A

Trial Application of the Subcounty Emission Allocation Procedures to Fulton County, Georgia

A.1 Introduction

This appendix illustrates results from the practical application of the methodology for Allocating Projected Emissions to Subcounty Areas to Fulton County (Atlanta), Georgia. Fulton was selected as a case study for this procedure because it represents a typical medium-sized Air Quality Control Region (AQCR) county. The case study therefore provides a reasonable example of the kinds of data that are available, the types of assumptions that will be necessary to apply these data to the methodology, and the level of effort needed to complete the allocations for an average size county.

It has been impossible to append to this volume of the Guidelines all of the tables necessary for the Fulton County test case. Therefore, the results of this practical exercise have been published in two Appendices. Appendix A, which is here attached to Volume 13, describes how data were adapted for implementation and briefly highlights results obtained from the Fulton County analysis. The complete set of tables generated for the test case have been published separately as Appendix B. Copies of Appendix B are available upon request from the USEPA Air Pollution Technical Information Center, Research Triangle Park, North Carolina 27711 and from the National Technical Information Service, 5825 Port Royal Road, Springfield, Virginia 22161.

In addition to this introduction, which constitutes Section 1, Appendix A is divided into three other sections. Section 2 is subdivided into five parts that correspond with each of the different types of sources treated in Allocating Projected Emissions to Subcounty Areas (e.g., residential fuel combustion, transportation, commercial/institutional fuel combustion, industrial process and fuel combustion, and solid waste incineration. Each of these sections discusses the allocation Order applied, data employed, assessments of the quality and suitability of these data to the specified procedure,

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problems encountered, and assumptions in force. The text pertaining to each source category also includes a brief summary of emission results and, where possible, compares the results with calculations that have been independently prepared elsewhere. Section 3 of Appendix A deals with the master gridding technique applied to Fulton County. The procedure is described and a map illustrating the gridded overlay is presented. Section 4 presents the final output of the subcounty emission allocation methodology. In addition to illustrating the summary tables, conclusions and recommendations for further analysis are presented here.

A.2 Emission Sources

A.2.1 Residential Fuel Combustion Emissions

To gain a better understanding of the sensitivity of area source (e.g., residential fuel combustion, commercial/institutional fuel combustion and solid waste incineration) emission calculations to the choice of allocation Order, residential fuel combustion emissions were computed for 1970, using each of the three Orders. While there was no significant difference in the estimates of countywide fuel use when treated by the different Orders, the Order 3 estimates of fuel combustion for particular subareas were different from those derived from the Order 1 and 2 computations. Therefore, because the Order 3 calculation typically yields a more accurate characterization of fuel use for particular subareas, it should be preferred wherever data and resources permit its use.

Fulton County's residential fuel combustion emissions were projected for 1975, 1980, and 1985 using an Order 3 analysis. The number of dwelling units in each of seven municipalities within Fulton County was obtained for 1970 from the 1972 County and City Databook, and projections for the number of households in these subareas for 1975, 1980, and 1985 were taken from computer output supplied by the Atlanta Regional Commission (ARC). Growth factors for the five-year periods 1970-75, 1975-80, and 1980-85 were then computed for the households in each subarea. Table A.2-1 enumerates the raw household data and the growth factors that were developed from them. These growth factors were then sequentially applied to the 1970 dwelling-unit base data to project the number of dwelling units in each subarea for 1975, 1980, and 1985. Thus, by making the assumption that the number of households mirrors the number of dwelling units, it was possible to carry out the Order 3 computation.

Residential building size and fuel use distributions were obtained from the 1970 Census of Housing. As it was not possible to obtain these data from the ARC Data Center, the building size and fuel use distributions were held constant from 1970 through 1985. The fuel combustion emission factors taken from The Compilation of Air Pollutant Emission Factors (AP-42) were also held constant over the study period. Therefore, because it was assumed that the number of dwelling units changed, proportionate to the five-year growth rates, emissions were sequentially calculated for each forecast year as the

Table A.2-1

Total Households and Growth Factors
Fulton County, Georgia

Subareas	Households 1970	Growth Factor 1970-75	Households 1975	Growth Factor 1975-80	Households 1980	Growth Factor 1980-85	Households 1985	Households[a] 1990
Atlanta	148,750	1.04	155,113	1.04	161,473	1.07	173,383	185,293
Fairburn	1,211	1.36	1,642	1.26	2,074	1.40	2,913	3,752
Hapeville	3,517	1.06	3,747	1.06	3,977	1.04	4,152	4,328
Rosswell	2,326	1.47	3,428	1.32	4,531	1.32	6,035	7,539
Union City	1,893	1.50	2,840	1.33	3,787	1.32	4,998	6,210
East Point	13,005	1.16	15,156	1.14	17,306	1.09	18,874	20,441
College Park	5,446	1.35	7,356	1.26	9,267	1.12	10,356	11,444
SUBAREA TOTAL	176,151	1.08	189,282	1.07	202,415	1.09	220,711	239,007
Residual	21,401	1.52	32,538	1.23	43,674	1.47	64,151	84,628
FULTON COUNTY TOTAL	197,552	1.12	221,820	1.11	246,089	1.16	284,862	323,635

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[a] Growth factors were not computed for the five-year period 1985-90. The 1990 data were used only to interpolate the projected number of households for 1985.

product of the growth rate and emissions from the previous year beginning with 1970 as the base year. The 3.1-9 Tables illustrate Fulton County emissions distributed among the seven municipalities and the Residual for 1970 and 1975.

Minor problems were encountered in trying to determine the geographic compatibility between municipalities as defined by the U.S. Bureau of the Census and ARC, and it was necessary to assume a one-to-one relationship between household and dwelling unit growth rates. Nevertheless, we feel that this Order 3 analysis provided more realistic estimates of emissions for the particular municipalities than would have been the case if Orders 1 and 2 had been used. We would, therefore, encourage prospective users to make similar assumptions if they lead to the use of data that facilitate the application of Order 3.

Table 3.1-9

Residential Fuel Combustion Emissions Allocated to Subcounty Areas

A. County Fulton
B. Year 1970
C. Allocation Order 3

(1) Subarea	Emissions (tons/yr) (2) Part.	(3) SO_x	(4) CO	(5) HC[a]	(6) NO_x[a]
Atlanta	146.74	197.75	136.36		
Fairburn	2.16	6.13	1.63		
Hapeville	7.15	20.21	5.57		
Rosswell	3.37	9.54	2.62		
Union City	1.74	4.91	1.36		
East Point	26.02	73.51	20.28		
College Park	2.77	.09	2.92		
SUBAREA TOTAL	189.96	312.16	170.73		
Residual	51.52	145.85	40.11		
D. COUNTY TOTAL	241.48	457.99	210.84		

[a] These pollutants have been excluded from this analysis as they will be treated on an AQCR basis.

Table 3.1-9

Residential Fuel Combustion Emissions Allocated to Subcounty Areas

A. County Fulton
B. Year 1975
C. Allocation Order 3

(1) Subarea	Emissions (tons/yr) (2) Part.	(3) SO_x	(4) CO	(5) HC[a]	(6) NO_x[a]
Atlanta	153.05	206.25	142.22		
Fairburn	2.93	8.31	2.21		
Hapeville	7.61	21.52	5.93		
Rosswell	4.97	14.06	3.86		
Union City	2.61	7.36	2.04		
East Point	30.31	85.64	23.63		
College Park	3.74	.12	3.94		
SUBAREA TOTAL	205.22	343.26	183.83		
Residual	78.31	221.69	60.97		
D. COUNTY TOTAL	283.53	564.95	244.80		

[a] These pollutants have been excluded from this analysis as they will be treated on an AQCR basis.

A.2.2 Transportation Emissions

An Order 1 analysis was used to project and allocate transportation emissions in Fulton County because more detailed data needed to carry out the higher Order calculations could not be obtained and implemented within the time frame of the case study. This analysis was confined to limited and non-limited access highways, and we feel that the motor vehicle emissions estimates are conservative (i.e., high), because the method used to forecast emissions was not adjusted to consider the existence and/or expansion of the Metropolitan Atlanta Rapid Transit System (MARTA) or the construction of any additional highway or arterial street links. Therefore, the emission forecasts for 1975, 1980, and 1985 are not expected to be representative of the actual situation in Fulton County, Georgia.

Necessary forecasts of Vehicle Miles Traveled (VMT) were derived from population projections. Population data for Fulton County and each of the seven municipalities used as subareas for the residential fuel combustion analysis were obtained for 1970, 1980, and 1990 from ARC. Population growth rates were then calculated for each of the three five-year intervals (1970-75, 1975-80, and 1980-85) by interpolating from the decade-based data, such that the percentage growth in the first five years equaled the percentage growth in the second five years. These population growth rates for the Fulton County subareas are shown in Table A.2-2.

VMT for limited and non-limited access highways were derived from the population forecasts using 1970 as the base. VMT for each limited access highway link was then calculated successively for each projection year (1975, 1980, and 1985) by multiplying VMT from the previous year (beginning with 1970) by the countywide population growth rate for the appropriate five-year interval. Thus, annual miles driven on limited access highways for each vehicle class is assumed to increase at the same rate as total population growth in the county, and the volume on every highway link is assumed to grow at these same rates. Growth in VMT for non-limited access highways was also linked to population growth. But instead of keying it to estimates of countywide population growth, non-limited access highway links were specifically located in the seven municipalities or treated as rural road links. In this way VMT increases for non-limited access highways were broken down and projected according to growth rates for the specific subareas considered (e.g., municipalities).

Table A.2-2

Population Growth Factors: Fulton County, Georgia

Subareas	1970-75	1975-80	1980-85
Atlanta	.97	.96	1.04
Fairburn	1.47	1.48	1.33
Hapeville	1.02	1.03	.98
Rosswell	1.64	1.65	1.32
Union City			1.28
East Point	1.11	1.11	.99
College Park	1.42	1.41	1.06
SUBAREA TOTAL	1.01	1.02	1.05
Residual	1.33	1.33	1.45
FULTON COUNTY TOTAL	1.05	1.05	1.13

The above procedures were implemented merely as substitutes for State Highway Department projections of VMT that could not be obtained in time to prepare the Fulton County example. Due to extensive transportation planning at the state and county levels and the Federal Highway Administration 3-C planning requirements, it is unlikely that similar deficiencies of data will occur where the Subcounty Emission Allocation procedures are to be applied. Therefore, it is not recommended that forecasts be developed using the procedure employed here, because the effects of all known changes, such as Atlanta's new transit system (MARTA) and proposed highway construction, should be accounted for in any forecast of VMT.

Two additional assumptions were employed in the Fulton County test case. These are more generally applicable to the country as a whole, and we recommend their use where data are lacking for a specific county under study. First, the national average vehicle age distribution from the Compilation of Air Pollutant Emission Factors (AP-42), weighted by annual miles driven in Fulton County, was applied to all forecast years. We reasoned that the vehicle age distribution will change in the future but such modified projections could not be obtained. Second, the speed correction factors for limited access highways were also determined using AP-42 and the average speed for these highways was assumed to be 45 mph, which is a conservative estimate.

As an overall assessment of these estimates for mobile source emissions, correlation analyses conducted at Argonne have indicated that population is a rather strong predictor of VMT. Based on these results, the emission estimates developed in this population-based analysis are judged to be as refined as the Order 1 procedure will permit under the conditions specified above. The availability of more refined highway data and a mobile source emissions model would undoubtedly yield more accurate predictions of transportation emissions than has been possible here. The 3.2-11 Table illustrates the summary allocation of transportation emissions to subareas of Fulton County for 1980.

Table 3.2-11

Transportation Emissions Allocated to Subcounty Areas

A. County Fulton
B. Year 1980
C. Allocation Order 1

	Emissions (tons/yr)				
(1) Subarea	(2) Part.	(3) SO_x	(4) CO	(5) HC[a]	(6) NO_x[a]
Atlanta	527.0	202.2	31975.8		
Fairburn	8.3	3.2	492.6		
Hapeville	12.6	4.9	748.4		
Rosswell	18.4	7.1	1100.4		
Union City	15.9	6.1	945.0		
East Point	60.1	23.2	3585.7		
College Park	30.9	11.9	1833.7		
SUBAREA TOTAL	672.8	259.3	40681.5		
Residual	204.0	78.6	12208.2		
D. COUNTY TOTAL	876.8	337.9	52889.7		

[a] These pollutants have been excluded from this analysis as they will be treated on an AQCR basis.

A.2.3 Commercial/Institutional Fuel Combustion Emissions

An Order 2 analysis was performed to allocate emissions resulting from the combustion of fuel used to heat commercial and institutional buildings in Fulton County. This was chosen as the highest Order of analysis feasible because the building size and fuel use distributions required for an Order 3 analysis were not available. Therefore, the allocated emissions derived from this investigation are characteristic of those that can be anticipated from the intermediate level of detail.

To obtain projections of commercial/institutional employment necessary for the Order 2 analysis, data were obtained from ARC and the 1972 County and City Databook. The employment projections supplied by ARC were provided in the form of computer output displaying the total number of employees for 1970, 1980 and 1990 in each of ten Superdistricts that comprise Fulton County. These Superdistricts were listed as follows:

Number	Designation
10	Atlanta, CBD
11	Atlanta, Northeast
12	Atlanta, Northwest
13	Atlanta, Southeast
14	Atlanta, Southwest
15	Tri-Cities
16	South Fulton
17	Atlanta, Buckhead
18	Sandy Springs
19	North Fulton

As a first step the total number of employees for 1970, 1980 and 1990 were interpolated to obtain estimates of 1975 and 1985 employment for the County and each of the Superdistricts.

Since the ARC data enumerated only the total number of employees, it was necessary to estimate the number of persons employed in commercial and institutional establishments, based on 1970 employment percentages enumerated in the Databook. The percentage of commercial/institutional employees was developed for the county and municipalities with 1970 populations of 25,000 or more, by summing the employment percentages for wholesale and retail trade, services and educational services available in the Databook. Because the applicable information in the Databook pertained only to municipalities with 1970 populations of 25,000 or more, the commercial/institutional employment percentages were applied to the various Superdistricts in the following way. A constant commercial/institutional percentage was applied to each of the six Atlanta Superdistricts (numbers 10, 11, 12, 13, 14 and 17). By the same token, the commercial/institutional employment percentage obtained for East Point was applied to the Tri-Cities Superdistrict (Number 15).* Using the total number of employees from the ARC data and the employment percentages derived from the Databook, the number of commercial/institutional employees were calculated for the County as a whole and for Superdistricts 10, 11, 12 13, 14, 15 and 17. These numbers were obtained for each area by multiplying the total number of employees by the commercial/institutional employment percentage. The 1970 commercial/institutional employment percentage was uniformly applied to the total number of employees for 1970 and each forecast year (1975, 1980 and 1985) to obtain the number of commercial/institutional employees for each year under investigation. This calculation is summarized in formula (1).

$$(1) \quad CIE_{ij} = TE_{ij} \times PCIE_{i1970}$$

where:

CIE_{ij} = Commercial/institutional employees in Superdistrict (or County) i in year j.

TE_i = Total employees in Superdistrict (or county) i in year j.

$PCIE_{i1970}$ = Percent of employment in commercial and institutional establishments in Superdistrict (or county) i in 1970.

---

*Although there are three municipalities (College Park, East Point and Hapeville) located in this Superdistrict, only East Point had a 1970 population greater than 25,000 and was therefore the only place for which data were enumerated in the 1972 County and City Databook.

The remaining Superdistricts (e.g., numbers 16, South Fulton; 18, Sandy Springs; and 19, North Fulton) were treated as the Residual for Fulton County because the necessary commercial/institutional employment percentages for these areas could not be obtained from the Databook. Thus, the number of employees treated in this Residual had to be estimated from the county total and Superdistricts already considered. The commercial/institutional employees for Superdistricts 10, 11, 12, 13, 14, 15 and 17 were summed and this result was subtracted from the total number of commercial/institutional employees for Fulton County to obtain the commercial/institutional employees for the Residual.

The number of employees used to generate the proportions by which commercial/institutional emissions were allocated are shown in Table A.2-3. The 3.3-11 Table illustrates allocated commercial/institutional fuel combustion emissions for 1975.

Table A.2-3

Commercial/Institutional Employment: Fulton County, Georgia

SD #	Name	1970	1975	1980	1985
10	Atlanta, CBD	41,877	45,091	48,305	50,925
11	Atlanta, Northeast	37,957	38,150	38,342	38,777
12	Atlanta, Northwest	21,211	23,736	26,261	29,249
13	Atlanta, Southeast	18,619	19,641	20,663	22,046
14	Atlanta, Southwest	14,800	16,064	17,329	20,149
17	Atlanta, Buckhead	13,798	15,801	17,804	19,877
15	Tri-Cities	16,511	18,151	19,790	22,471
	Residual[a]	4,858	10,664	16,470	23,505
FULTON COUNTY TOTAL		169,631	187,298	204,964	226,999

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[a] This residual is comprised of superdistricts #16 (South Fulton), #18 (Sandy Springs) and #19 (North Fulton).

Table 3.3-11

Commercial/Institutional Fuel Combustion Emissions Allocated to Sub-County Areas

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A. County Fulton
B. Year 1975
C. Allocation Order 2

(1) Subarea	Emissions (tons/yr)				
	(2) Part.	(3) SO_x	(4) CO	(5) HC^a	(6) $NO_x{}^a$
10 - CBD	55.95	85.02	47.25		
11 - Northeast	47.12	71.59	39.80		
12 - Northwest	29.48	44.80	24.90		
13 - Southeast	24.37	37.02	20.58		
14 - Southwest	19.96	30.35	16.86		
15 - Tri-Cities	22.53	34.22	19.02		
17 - Buckhead	19.51	29.63	16.47		
SUBAREA TOTAL	218.92	332.63	184.88		
Residual	13.23	20.09	11.17		
D. COUNTY TOTAL	232.15	352.72	196.05		

[a] These pollutants have been excluded from this analysis as they will be treated on an AQCR basis.

A.2.4 Industrial Process and Fuel Combustion Emissions

It was impossible to survey the management of industrial sources in Fulton County regarding their plans for expanding existing facilities or constructing plants at new sites. Therefore, the direct application of an Order 3 analysis could not be achieved and features of Orders 2 and 3 have been combined to yield the most extensive analysis possible. This approach illustrates options that are available to the innovative user who wants to obtain refined estimates of industrial emissions, but who is constrained because the detailed field survey information required for an Order 3 analysis is lacking.

Ideally, the purest application of an Order 3 analysis requires that the proposed size (i.e., anticipated employment levels) and location of new industrial sources be known. Since field surveys could not be administered, projections of new source employment levels were not available for Fulton County. Therefore, the growth of new point sources was estimated on the basis of growth in industrial land use, and emissions attributable to the construction of new plants were allocated according to these subarea-specific changes in industrial land use. Land use data were obtained from ARC for each of the ten areas called Superdistricts that comprise Fulton County (see Section A.2.3 of this Appendix for a list of these Superdistricts). These data provided an inventory of used acreage for 1970 as well as projections of used land for 1980 and 1990. After interpolating to obtain projections of the total land area projected to be in use for 1975 and 1985, the number of acres devoted to industrial activity in each Superdistrict was calculated. This industrial land area was obtained for each year under investigation (1970, 1975, 1980 and 1985) by multiplying the total acreage of used land in each Superdistrict by the percent of used acreage devoted to industrial activity in each Superdistrict. Formula (2) summarizes this calculation.

$$(2) \quad IA_i = TAU_i \times PAU_i \times PIA_i$$

where:

IA_i = Industrial acreage in Superdistrict i

TAU_i = Total acres used in Superdistrict i.

PAU_i = Percent of acreage used in Superdistrict i.

PIA_i = Percent of total acreage used, devoted to industrial activity in Superdistrict i.

The Superdistrict-specific change in industrial acreage was then computed for the five-year intervals 1970-75, 1975-80 and 1980-85 by subtracting the industrial acreage for each forecast year from the industrial acreage for the baseline year (1970). This calculation is summarized by formula (3).

$$(3) \quad \Delta IA_{ij} = IA_{ij} - IA_{i1970}$$

where ΔIA_{ij} = Change in industrial acreage for Superdistrict i between forecast year j and 1970.

IA_{ij} = Industrial acreage for Superdistrict i in forecast year j.

$IA_{i\ 1970}$ = Industrial acreage for Superdistrict i in 1970.

To allocate the forecast-year-specific change in industrial land among the various Superdistricts, the results obtained from the application of formula (2) were divided by the difference in the countywide industrial acreage between 1970 and the forecast year in question. The calculation for this industrial land use growth factor is illustrated in formula (4).

$$(4) \quad \Delta AREA_{ij} = \frac{IA_{ij}}{TIA_j - TIA_{1970}}$$

where:

$\Delta AREA_{ij}$ = Change in industrial land area apportioned to Superdistrict i for forecast year j.

ΔIA_{ij} = Change in industrial acreage for Superdistrict i between forecast year j and 1970.

TIA_j = Total industrial acreage for Fulton County in forecast year j.

TIA_{1970} = Total industrial acreage for Fulton County in 1970.

This subarea-specific growth factor for industrial land use was then used to allocate emissions attributable to the siting of new point sources in each Superdistrict. The industrial acreage and land use growth factor for each of the ten Fulton County Superdistricts is shown in Table A.2-4.

Table A.2-4
Industrial Land Use Change
Fulton County, Georgia

Subareas	Industrial Land Use[a] (ACRES)				Industrial Land Use Change[b]		
	1970	1975	1980	1985	1970-75	1975-80	1980-85
10 Atlanta, CBD	133	132	132	131	-0.002	-0.001	-0.001
11 Atlanta, Northeast	795	735	675	707	-0.126	-0.127	-0.054
12 Atlanta, Northwest	1665	1759	1852	1956	0.198	0.197	0.179
13 Atlanta, Southeast	1137	1151	1165	1198	0.030	0.030	0.038
14 Atlanta, Southwest	930	1006	1082	1182	0.160	0.160	0.155
15 Tri-Cities	825	846	868	912	0.044	0.045	0.054
16 South Fulton	216	420	623	795	0.430	0.429	0.357
17 Atlanta, Buckhead	125	146	167	195	0.044	0.045	0.043
18 Sandy Springs	121	169	216	255	0.101	0.100	0.147
19 North Fulton	88	145	203	326	0.120	0.121	0.147
FULTON COUNTY TOTAL	6035	6509	6983	7657	474	948	1622

[a] Equivalent to IA specified in formula (1).

[b] Equivalent to ΔAREA specified in formula (3).

Using identification coordinates listed in the National Emissions Data Systems (NEDS), all point sources were located on a map of Fulton County indicated with Universal Transmercator (UTM) grid tics and boundaries of the 10 ARC Superdistricts. These sources were then grouped within each Superdistrict according to industrial process categories delineated in the OBERS projections of economic activity. Each source's pollutant-specific emissions for the base year (1970) were then recorded from the NEDS file for Fulton County onto the appropriate working tables. Next, the total emissions for each source were calculated for each forecast year (1975, 1980, and 1985). This was accomplished by multiplying the source's 1970 baseline emissions by the growth factor for its industrial process category determined from the OBERS projections for the Atlanta SMSA. Emissions attributable to the construction of sources at new locations were estimated on the basis of the five-year growth rate for the number of acres devoted to industrial land in each of the ten Superdistricts. These new source emissions were calculated for each process category by multiplying the total emissions in each Superdistrict by the industrial land use growth factor ($\Delta AREA_{ij}$) described above. This rather intricate procedure had the effect of apportioning the estimated growth in industrial emissions between existing (in situ) sources and the construction of plants at new sites. Therefore, this application illustrates the Order 3 allocation of industrial emissions but relies on an estimate of growth at new sites, which is characteristic of the Order 2 procedure.

Two problems worth mentioning were encountered in the application of this procedure. In the first place it was necessary to assume that the point source emissions for any given forecast year could not be less than the baseline year emissions for that source. In the special case(s) where projected emissions at existing sources were smaller than the 1970 emissions for a given source(s) (due to the subtraction of new source emissions that were larger than the total projected emission for that year), the 1970 baseline year emissions, instead of estimated new source emissions, were subtracted from the total forecasted emissions. Projected emissions for an existing point source were thereby constrained so that they were at least equal to that point source's emissions for the baseline year. In the second instance where an industrial land use change factor ($\Delta AREA_i$) was negative for a given Superdistrict, zeros were entered for new source growth and all of the total emissions were allocated to existing sources.

Tables 3.4-4 and 3.4-8 respectively summarize the 1985 industrial process and industrial fuel combustion emissions allocated to the various Superdistrict subareas.

Table 3.4-4
Industrial Point and New Source Process
Emissions - Subarea Summary

A. County FULTON
B. Subarea SUMMARY
C. Year 1985
D. Allocation Order 2-3

SUBAREA	POINT SOURCE EMISSIONS							NEW SOURCE EMISSIONS						TOTAL EMISSIONS					
(1)	(2) No. of SOURCES	(3) EMP	(4) PART	(5) NO_x	(6) SO_x	HCa	(8) CO a	(9) EMP	(10) PART	(11) NO_x	(12) SO_x	(13) HC a	(14) CO a	(15) EMP	(16) PART	(17) NO_x	(18) SO_x	(19) HC a	(20) CO a
10	4		2114	491	1625				0	0	0				2114	491	1625		
11	10		11195	109	2087				0	0	0				11195	109	2087		
12	8		9681	312	1247				2115	68	272				11796	380	1519		
13	5		35	75	27				1	2	1				36	77	28		
14	2		2	14	2				0	2	0				2	16	2		
15	7		1056	56	710				60	3	40				1116	59	750		
16	3		577	363	22				321	201	12				898	564	34		
17	1		2	0	0				0	0	0				2	0	0		
18	0		0	0	0				0	0	0				0	0	0		
19	0		0	0	0				0	0	0				0	0	0		
COUNTY TOTAL	48		24700	1422	5720				2489	274	325				27189	1696	6045		

[a] These pollutants have been excluded from this analysis as they will be treated on an AQCR basis.

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Table 3.4-8
Industrial Point and New Source Fuel Combustion Emissions - Subarea Summary

A. County FULTON
B. Subarea SUMMARY
C. Year 1985
D. Allocation Order 2-3

SUBAREA	POINT SOURCE EMISSIONS							NEW SOURCE EMISSIONS						TOTAL EMISSIONS					
(1)	(2) No. of Sources	(3) [illegible]	(4) [illegible]	(5) [illegible]	(6) [illegible]	(7) [illegible] a	(8) [illegible] a	(9) [illegible]	(10) [illegible]	(11) [illegible]	(12) [illegible]	(13) [illegible] a	(14) [illegible] a	(15) [illegible]	(16) [illegible]	(17) [illegible]	(18) [illegible]	(19) [illegible] a	(20) [illegible] a
10	1		3528	484	1534				0	0	0				3528	484	1534		
11	2		13	100	46				0	0	0				13	100	46		
12	1		2859	268	837				625	59	183				3484	327	1020		
13	1		11	345	2				0	14	0				11	359	2		
14	0		0	0	0				0	0	0				0	0	0		
15	0		0	0	0				0	0	0				0	0	0		
16	2		23	291	3				12	162	1				35	453	4		
17	0		0	0	0				0	0	0				0	0	0		
18	0		0	0	0				0	0	0				0	0	0		
19	0		0	0	0				0	0	0				0	0	0		
COUNTY TOTAL	7		6434	1488	2422				637	235	184				7071	1723	2606		

[a] These pollutants have been excluded from this analysis as they will be treated on an AQCR basis.

A.2.5 Solid Waste Incineration Emissions

Emissions generated from the incineration of solid waste were allocated to subcounty areas using an Order 2 analysis. This Level of detail was selected because the survey of local solid waste officials needed for an Order 3 analysis could not be undertaken as part of the Fulton County test case. Furthermore, the intensive study prescribed in Projecting County Emissions: Volume 7 of the Guidelines was not carried out. Estimates of the countywide solid waste incineration were instead taken directly from the Atlanta Air Pollutant Emission Inventory (October, 1969) and entered in Table 3.5-2 as described in the procedural instructions. In view of the fact that residential solid waste incineration was not considered in this Inventory, it has also been deleted from this analysis. This exclusion should not, however, create undue concern as residential refuse incineration is generally considered to account for only a very small portion of the emissions from open burning. In short, it can be said that the allocation results obtained from this analysis are as representative of the actual situation in Fulton County as could be expected without projecting solid waste incineration Levels, using the procedures described in Volume 7 of the Guidelines.

All of the fundamental work involved in manipulating the demographic and land use variables used to project solid waste emissions has already been carried out for the analyses of other emission sources. Residential incineration has been deleted so that the population allocations (developed for the analysis of transportation emissions) were not needed. The commercial/institutional establishments and industrial point sources have already been treated according to ARC Superdistricts that are compatible. Therefore, the commercial/institutional and industrial land use allocation proportions derived from the assumptions, specified in Sections A.2.3 and A.2.4 of this appendix, have been directly applied to this analysis of solid waste incineration emissions. One minor adaptation was necessary, however. To make the commercial/institutional and industrial subarea designations completely compatible, Superdistricts 16, 18 and 19, which were treated separately for industrial sources, have been aggregated and treated as the Residual for this analysis.

The following 3.5-4 Table illustrates the allocated refuse incineration emissions for 1980.

Table 3.5-4
Solid Waste Incineration Emissions Allocated to Subcounty Areas

A. County Fulton
B. Year 1980
C. Allocation Order 2

(1) Sub-areas	Emissions (tons/yr) (2) Part.	(3) SO_x	(4) CO	(5) HC[a]	(6) NO_x[a]
10 - CBD	529	78	208		
11 - Northeast	966	104	193		
12 - Northwest	1,985	175	199		
13 - Southeast	1,286	116	143		
14 - Southwest	1,179	105	125		
15 - Tri-Cities	991	92	124		
17 - Buckhead	308	38	82		
SUBAREA TOTAL	7,244	708	1,074		
Residual	1,130	100	119		
D. COUNTY TOTAL	8,374	808	1,193		

[a] These pollutants have been excluded from this analysis as they will be treated on an AQCR basis.

A.3 MASTER GRIDDING

To this point emissions from the five types of sources have been allocated to essentially two types of subarea sets. Residential fuel combustion and transportation emissions have been allocated to municipalities and a Residual. Industrial emissions have been allocated to ARC Superdistricts and a Residual was not necessary; and commercial/institutional fuel combustion and solid waste incineration emissions were allocated to ARC Superdistricts and a Residual. While there is no conceptual problem with treating these different subarea sets separately for dispersion modeling purposes, the overlap between the subareas presents a rather confusing picture as to where emission control strategies should be implemented. Therefore, we have followed our previous recommendation and developed a single master grid network so that the emissions from all of the previous analyses could be totaled for each cell in the square-gridded matrix.

Fulton County was subdivided into 123 cells using a two-stage gridding procedure applied to census tract maps of the Atlanta Standard Metropolitan Statistical Area (SMSA) on which the ARC Superdistrict boundaries were indicated. The resulting grid system is shown in Figures A.1 and A.2. Figure A.1 represents the master census tract map and Figure A.2 is a blow-up of the census tracts for "INSERT A" specified in Figure A.1. Since two maps were needed to show the resolution of census tracts in and around Atlanta, one grid network had to be drawn on the larger-scale map and another grid had to be drawn on the smaller-scale map. This accounts for the two-stage operation mentioned above.

The master grid system was developed in the following way. First, clear Mylar plastic was overlayed on both of the maps and identical Universal Transverse Mercator (UTM) coordinates were marked on each overlay. For example, UTM coordinate $37^{26} - 7^{25}$ can be seen on both maps and designates an interface between them. Next, the scales of gridding resolution were decided upon and the cell networks were drawn on both maps. Since outlying areas have comparatively low population densities and concentrations of emission generating activity, 8 km x 8 km grid squares were chosen. These larger grid cells are evident in Figure A.1 and they cover the three Superdistricts surrounding Atlanta (e.g., 16, South Fulton; 18, Sandy Springs; and 19, North Fulton). The 8 km x 8 km grid cells do not apply to "INSERT A," but was also gridded with the uniform cells to avoid confusion in drawing the complete matrix on the

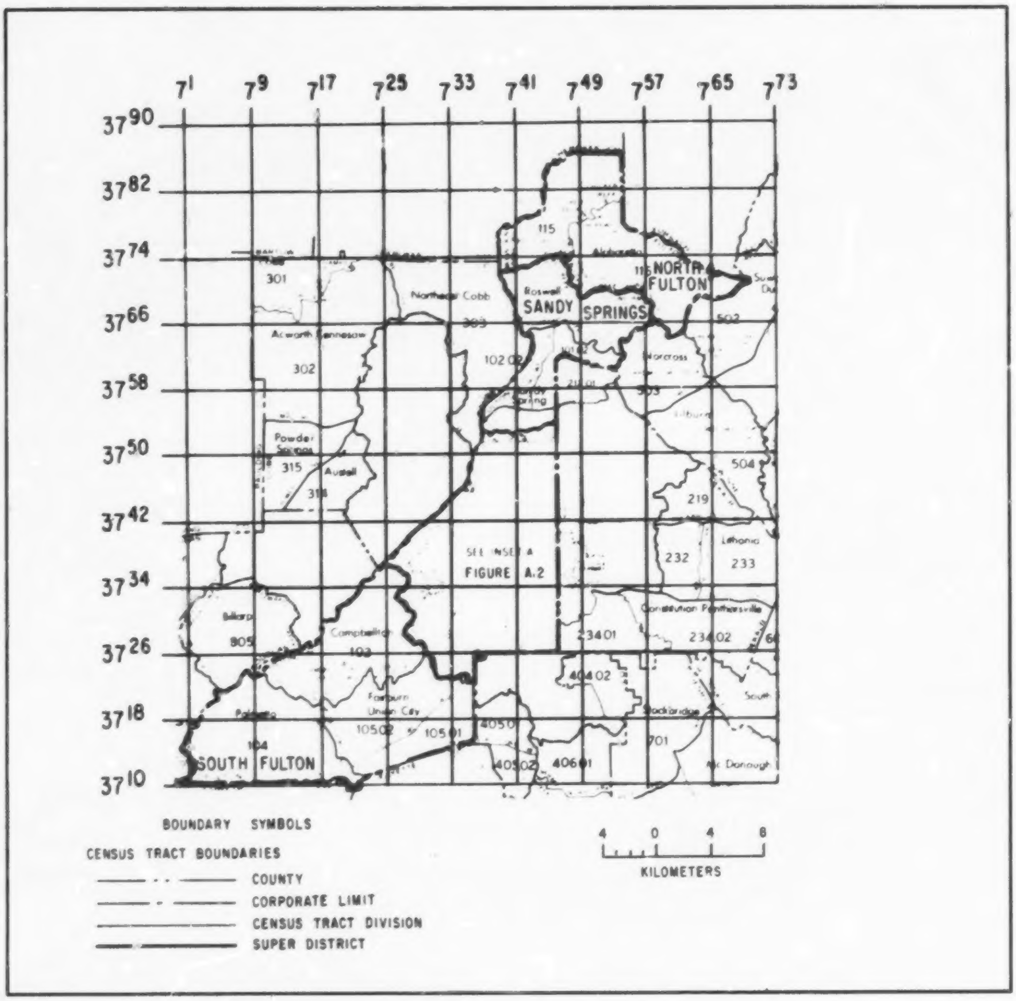
7^{1}
7^{9}
7^{17}
7^{25}
7^{33}
7^{41}
7^{49}
7^{57}
7^{65}
7^{73}
37^{90}
37^{82}
37^{74}
37^{66}
37^{58}
37^{50}
37^{42}
37^{34}
37^{26}
37^{18}
37^{10}
115
Alpharetta
116
NORTH FULTON
Roswell
SANDY SPRINGS
301
Northeast Cobb
303
Acworth Kennesaw
302
102 02
101 02
211 01
Norcross
503
502
Lilburn
Powder Springs
315
Austell
314
504
219
SEE INSET A
FIGURE A.2
232
Lithonia
233
Bilkerp
805
Campbellton
103
Constitution Panthersville
234 01
234 02
404 02
Fairburn
Union City
Stockbridge
South
Palmetto
104
105 02
105 01
405 01
405 02
406 01
701
Mc Donough
SOUTH FULTON
BOUNDARY SYMBOLS
CENSUS TRACT BOUNDARIES
COUNTY
CORPORATE LIMIT
CENSUS TRACT DIVISION
SUPER DISTRICT
4
0
4
8
KILOMETERS

Figure A.1 Master Grid Overlay

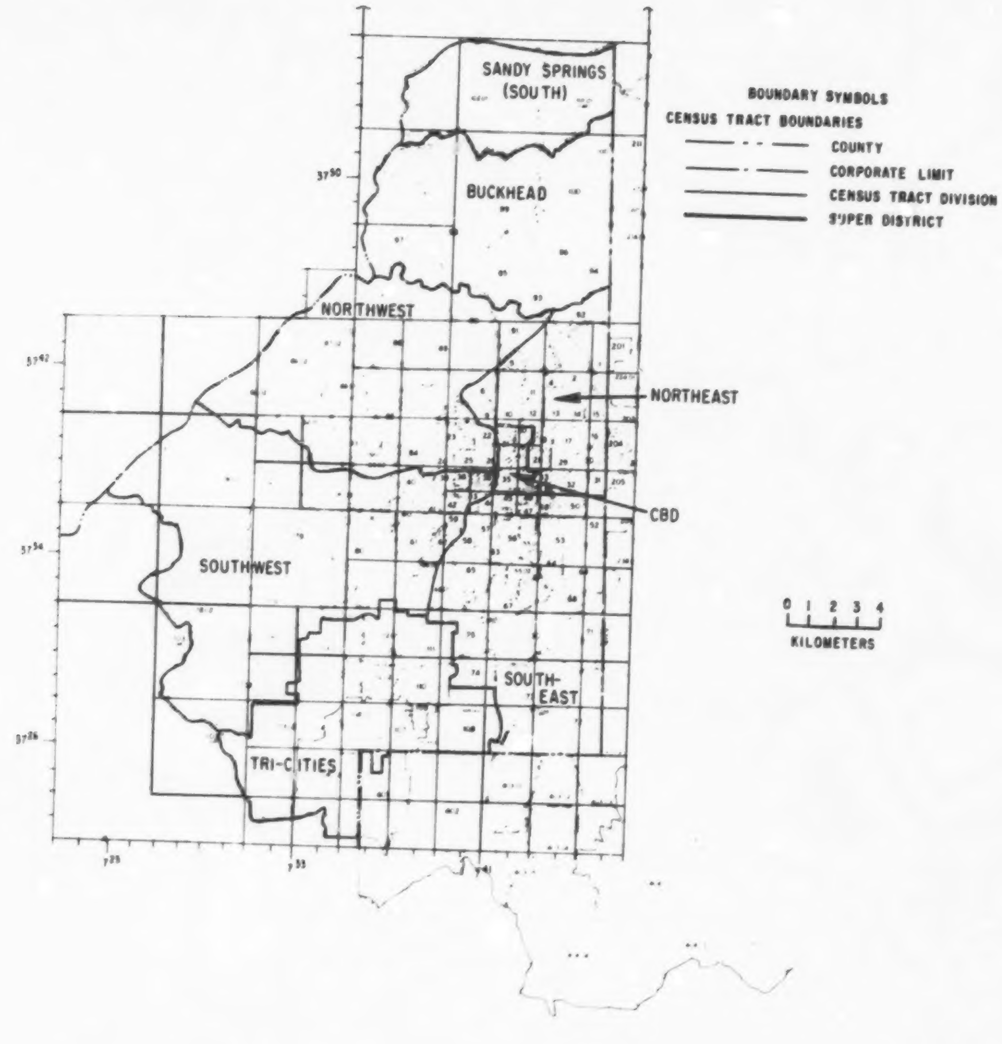
SANDY SPRINGS (SOUTH)
BUCKHEAD
NORTHWEST
NORTHEAST
CBD
SOUTHWEST
SOUTH-EAST
TRI-CITIES
BOUNDARY SYMBOLS
CENSUS TRACT BOUNDARIES
COUNTY
CORPORATE LIMIT
CENSUS TRACT DIVISION
SUPER DISTRICT
0 1 2 3 4
KILOMETERS
37^50
37^42
37^34
37^26
7^25
7^33
7^41

Figure A.2 Master Grid Overlay: Insert

master census tract. Figure A.2 shows that varying degrees of resolution in gridding were chosen for the seven Superdistricts in, and contiguous to, Atlanta. In the course of generating the cell matrix for Figure A.2 the map was originally divided into 8 km squares that were continually subdivided until the desired resolution was obtained. The Atlanta CBD was subdivided into the smallest cells (1 km square) and the areas of lesser concentrated activity around the CBD were divided into 2 km squares. The lower density, western and northwestern parts of Atlanta were divided into 4 km squares and the northeastern portion was divided into two 8 km squares.

After completing this gridding procedure on the census tract/Superdistrict maps the identical grid network was applied to a Fulton County map with municipalities indicated on it. In this way the subareas treated in the analyses of residential fuel combustion and transportation emissions were distributed to the appropriate cells of the grid network.

The final step of the master gridding procedure involved estimating portions of the various subcounty areas located in each of the master grid cells. To insure accuracy this apportioning was done with a planimeter and the fractional estimates for each subarea set were recorded in the 4.1 Tables. Examples of these 4.1 Tables for the residential fuel combustion-transportation and commercial/institutional-industrial-solid waste subarea sets are provided below.

Although the 123 cell network involved a considerable amount of effort in gridding and apportioning the various subareas, we feel that it provides optimal resolution for modeling air quality from the allocated emissions for Fulton County. This grid system is neither more refined than the original data sets would permit nor so gross that it destroys resolution achieved by the separate analyses.

Table 4.1

Master Grid Mapping

A. County Fulton
B. Subcounty Area Set Residential, Transportation

(1) Master Grid Designation	(2) Subcounty Area Designation	(3) Fraction of Subcounty Area in Master Grid
$37^{36} - 7^{33}$	Atlanta	.013
$37^{36}\ \ 7^{35}$		.013
$37^{36} - 7^{37}$		.013
$37^{37} - 7^{39}$		.003
$37^{37} - 7^{40}$		.003
$37^{36} - 7^{39}$		.003
$37^{36} - 7^{40}$		.003
$37^{36} - 7^{41}$		.003
$37^{36} - 7^{42}$		.003
$37^{34} - 7^{39}$		.013
$37^{34} - 7^{41}$		.013
$37^{34} - 7^{43}$		.013
$37^{34} - 7^{45}$		.005
$37^{34} - 7^{37}$		.013
$37^{32} - 7^{39}$		.009

Table 4.1

Master Grid Mapping

A. County Fulton
B. Subcounty Area Set Commercial/Institutional-Industrial-Solid Waste

(1) Master Grid Designation	(2) Subcounty Area Designation	(3) Fraction of Subcounty Area in Master Grid
37^{38} - 7^{41}	12-NW	.004
37^{39} - 7^{41}	12-NW	.001
37^{36} - 7^{39}	13-SE	.002
37^{36} - 7^{40}		.010
37^{36} - 7^{41}		.015
37^{36} - 7^{42}		.015
37^{36} - 7^{43}		.030
37^{36} - 7^{45}		.012
37^{34} - 7^{39}		.035
37^{34} - 7^{41}		.061
37^{34} - 7^{43}		.061
37^{34} - 7^{45}		.024
37^{34} - 7^{37}		.002
37^{32} - 7^{37}		.012
37^{32} - 7^{39}		.061

A.4 Master Grid Emissions

This last section of Appendix A briefly illustrates some of the final results from the Fulton County test case. Also described is an additional technique not treated in the text of Volume 13. This technique involves generating a table that shows how total emissions for each pollutant are distributed among the five sources in each grid square.

The 4.2 Tables included below show the final allocated emissions for grid squares 46 through 75 for each of the four years under study (1970, 1975, 1980 and 1985). These summary pages of the test case were selected for presentation because, as will be seen later, total 1970 emissions were disaggregated by source for grid squares 58, 59, 67 and 68. Therefore, the 4.2 Tables provide a reference for these grids and also show emission projection results for a range of grids in Fulton County. By following through the 4.2 Tables for a given grid square, one can see that the pollutant-specific emissions are, for the most part, growing between the five-year intervals. The major deficiency in simply inspecting the 4.2 Tables, however, is that the user cannot determine what sources account for major portions of the total emissions for each pollutant. In other words, the 4.2 Tables do not directly address the basic issue behind Air Quality Maintenance Planning; what emission control strategies should be implemented in a particular area (e.g., grid square)?

To overcome this deficiency, a closer examination of grid squares with high emission concentrations that signify specific air quality problems is strongly recommended. Total emissions tabulated in the 4.2 Tables should be disaggregated by source. A disaggregation of 1970 emissions is shown in Table A.4 for grids 58, 59, 67 and 68. These grids were selected for this demonstration because they are all 4-square-km cells and near the Atlanta CBD. While these four grids do not have the highest emission rates in Fulton County, they were selected as representative of the 2 km x 2 km squares that were developed for most of the county.

From Table A.4 it is readily evident that transportation accounts for the heavy concentrations of CO emissions in the four areas near the Atlanta CBD. In each case, automotive vehicles account for over 99% of an average CO level of 1713 tons/yr. Hence, a transportation plan designed to reduce VMT would be an appropriate strategy for lowering CO emissions in these areas.

Table 4.2

Master Grid Emissions

A. County Fulton
B. Year 1970

(1) Master Grid Designation	Emissions (tons/yr)				
	(2) Part.	(3) SO_x	(4) CO	(5) HC [a]	(6) NO_x [a]
46. 37^{30} - 7^{43}	90.1	15.7	1718.3		
47. 37^{30} - 7^{45}	37.9	11.5	661.4		
48. 37^{32} - 7^{23}	6.2	2.9	296.8		
49. 37^{32} - 7^{27}	146.2	24.0	2476.3		
50. 37^{32} - 7^{31}	184.3	36.6	5865.2		
51. 37^{32} - 7^{35}	46.0	7.9	5.0		
52. 37^{32} - 7^{37}	46.5	5.4	5.8		
53. 37^{32} - 7^{39}	87.1	14.0	1192.9		
54. 37^{32} - 7^{41}	90.1	15.7	1718.3		
55. 37^{32} - 7^{43}	90.1	15.7	1718.3		
56. 37^{32} - 7^{45}	37.9	6.4	661.4		
57. 37^{34} - 7^{35}	47.8	9.8	1711.9		
58. 37^{34} - 7^{37}	49.3	10.0	1712.2		
59. 37^{34} - 7^{39}	67.4	12.6	1715.1		
60. 37^{34} - 7^{41}	90.1	15.7	1718.3		

[a] These pollutants have been excluded from this analysis as they will be treated on an AQCR basis.

Table 4.2

Master Grid Emissions

A. County Fulton
B. Year 1970

(1) Master Grid Designation	Emissions (tons/yr)				
	(2) Part.	(3) SO_x	(4) CO	(5) HC [a]	(6) NO_x [a]
61. 37^{34} - 7^{43}	90.1	15.7	1718.3		
62. 37^{34} - 7^{45}	35.3	6.1	661.0		
63. 37^{36} - 7^{23}	23.5	3.0	48.4		
64. 37^{36} - 7^{27}	270.3	43.5	2325.3		
65. 37^{36} - 7^{31}	47.8	9.8	1711.9		
66. 37^{36} - 7^{33}	121.1	21.1	1712.9		
67. 37^{36} - 7^{35}	159.9	28.3	1713.6		
68. 37^{36} - 7^{37}	132.2	23.9	1713.2		
69. 37^{36} - 7^{39}	14.3	2.7	395.5		
70. 37^{36} - 7^{40}	18.5	3.4	396.2		
71. 37^{36} - 7^{41}	22.0	3.8	396.7		
72. 37^{36} - 7^{42}	22.0	3.8	396.7		
73. 37^{36} - 7^{43}	651.2	162.8	2203.5		
74. 37^{36} - 7^{45}	184.1	31.4	847.1		
75. 37^{37} - 7^{39}	50.5	8.7	395.9		

[a] These pollutants have been excluded from this analysis as they will be treated on an AQCR basis.

Table 4.2

Master Grid Emissions

A. County Fulton
B. Year 1975

(1) Master Grid Designation	Emissions (tons/yr)				
	(2) Part.	(3) SO_x	(4) CO	(5) HC[a]	(6) NO_x[a]
46. 37^{30}- 7^{43}	89.5	15.9	1016.9		
47. 37^{30}- 7^{45}	37.8	6.6	391.6		
48. 37^{32}- 7^{23}	7.8	4.3	307.1		
49. 37^{32}- 7^{27}	154.3	26.3	1567.3		
50. 37^{32}- 7^{31}	191.7	38.0	3492.2		
51. 37^{32}- 7^{35}	49.7	9.2	5.5		
52. 37^{32}- 7^{37}	48.3	5.9	6.3		
53. 37^{32}- 7^{39}	86.7	14.3	707.6		
54. 37^{32}- 7^{41}	89.5	15.9	1016.9		
55. 37^{32}- 7^{43}	89.5	15.9	1016.9		
56. 37^{32}- 7^{45}	37.8	6.6	391.6		
57. 37^{34}- 7^{35}	49.4	10.1	1010.1		
58. 37^{34}- 7^{37}	51.0	10.3	1010.4		
59. 37^{34}- 7^{39}	67.5	12.9	1013.5		
60. 37^{34}- 7^{41}	89.5	15.9	1016.9		

[a] These pollutants have been excluded from this analysis as they will be treated on an AQCR basis.

Table 4.2

Master Grid Emissions

A. County Fulton
B. Year 1975

(1) Master Grid Designation	Emissions (tons/yr)				
	(2) Part.	(3) SO_x	(4) CO	(5) HC[a]	(6) NO_x[a]
61. 37^{34}- 7^{43}	89.5	15.9	1016.9		
62. 37^{34}- 7^{45}	35.1	6.2	391.2		
63. 37^{36}- 7^{23}	25.1	3.4	50.2		
64. 37^{36}- 7^{27}	303.4	49.1	1469.8		
65. 37^{36}- 7^{31}	49.4	10.1	1010.1		
66. 37^{36}- 7^{33}	138.9	24.7	1011.2		
67. 37^{36}- 7^{35}	186.0	32.0	1012.0		
68. 37^{36}- 7^{37}	152.0	26.7	1011.5		
69. 37^{36}- 7^{39}	14.9	2.8	233.6		
70. 37^{36}- 7^{40}	18.7	3.4	234.3		
71. 37^{36}- 7^{41}	21.8	3.9	234.9		
72. 37^{36}- 7^{42}	21.8	3.9	234.9		
73. 37^{36}- 7^{43}	720.0	193.0	1360.5		
74. 37^{36}- 7^{45}	208.8	38.1	599.9		
75. 37^{37}- 7^{39}	59.1	9.9	234.0		

[a] These pollutants have been excluded from this analysis as they will be treated on an AQCR basis.

Table 4.2

Master Grid Emissions

A. County Fulton

B. Year 1980

(1) Master Grid Designation	Emissions (tons/yr)				
	(2) Part.	(3) SO_x	(4) CO	(5) HC [a]	(6) NO_x [a]
46. 37^{30} - 7^{43}	91.2	16.5	430.0		
47. 37^{30} - 7^{45}	38.5	6.8	163.9		
48. 37^{32} - 7^{23}	8.7	5.2	160.3		
49. 37^{32} - 7^{27}	165.1	28.1	687.2		
50. 37^{32} - 7^{31}	203.1	39.4	1471.1		
51. 37^{32} - 7^{35}	54.1	10.6	5.9		
52. 37^{32} - 7^{37}	51.0	6.3	6.8		
53. 37^{32} - 7^{39}	88.5	14.9	301.5		
54. 37^{32} - 7^{41}	91.2	16.5	430.0		
55. 37^{32} - 7^{43}	91.2	16.5	430.0		
56. 37^{32} - 7^{45}	38.5	6.8	165.9		
57. 37^{34} - 7^{35}	52.2	10.5	422.9		
58. 37^{34} - 7^{37}	53.7	10.7	423.1		
59. 37^{34} - 7^{39}	69.3	13.2	426.4		
60. 37^{34} - 7^{41}	91.2	16.5	430.0		

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[a] These pollutants have been excluded from this analysis as they will be treated on an AQCR basis.

Table 4.2

Master Grid Emissions

A. County Fulton
B. Year 1980

(1) Master Grid Designation	Emissions (tons/yr)				
	(2) Part.	(3) SO_x	(4) CO	(5) HC [a]	(6) NO_x [a]
61. $37^{34} - 7^{43}$	91.2	16.5	430.0		
62. $37^{34} - 7^{45}$	35.8	6.4	165.6		
63. $37^{36} - 7^{23}$	27.0	3.7	27.9		
64. $37^{36} - 7^{27}$	345.7	55.5	646.6		
65. $37^{36} - 7^{31}$	52.2	10.5	422.9		
66. $37^{36} - 7^{33}$	162.2	28.0	424.0		
67. $37^{36} - 7^{35}$	219.6	37.1	425.0		
68. $37^{36} - 7^{37}$	178.1	30.5	424.4		
69. $37^{36} - 7^{39}$	15.6	2.9	98.1		
70. $37^{36} - 7^{40}$	19.2	3.6	98.1		
71. $37^{36} - 7^{41}$	22.4	4.0	99.5		
72. $37^{36} - 7^{42}$	22.4	4.0	99.5		
73. $37^{36} - 7^{43}$	856.3	238.0	1078.7		
74. $37^{36} - 7^{45}$	243.3	44.2	254.5		
75. $37^{37} - 7^{39}$	70.3	11.6	98.6		

[a] These pollutants have been excluded from this analysis as they will be treated on an AQCR basis.

Table 4.2

Master Grid Emissions

A. County Fulton
B. Year 1985

Reproduced from best available copy.

(1) Master Grid Designation	(2) Part.	(3) SO_x	(4) CO	(5) HC[a]	(6) NO_x[a]
	Emissions (tons/yr)				
46. $37^{30} - 7^{43}$	94.1	17.1	286.0		
47. $37^{30} - 7^{45}$	39.7	7.1	110.6		
48. $37^{32} - 7^{23}$	11.5	7.5	180.7		
49. $37^{32} - 7^{27}$	181.5	32.1	515.2		
50. $37^{32} - 7^{31}$	220.2	42.6	986.5		
51. $37^{32} - 7^{33}$	59.9	12.1	7.1		
52. $37^{32} - 7^{35}$	55.2	6.9	7.5		
53. $37^{32} - 7^{39}$	91.4	15.4	202.2		
54. $37^{32} - 7^{41}$	94.1	17.1	286.0		
55. $37^{32} - 7^{43}$	94.1	17.1	286.0		
56. $37^{32} - 7^{45}$	39.7	7.1	110.6		
57. $37^{34} - 7^{35}$	46.4	11.1	278.1		
58. $37^{34} - 7^{37}$	57.9	11.4	278.4		
59. $37^{34} - 7^{39}$	63.4	14.0	281.9		
60. $37^{34} - 7^{41}$	94.1	17.1	286.0		

[a] These pollutants have been excluded from this analysis as they will be treated on an AQCR basis.

Table 4.2

Master Grid Emissions

Reproduced from best available copy.

A. County Fulton
B. Year 1985

(1) Master Grid Designation	Emissions (tons/yr)				
	(2) Part.	(3) SO_x	(4) CO	(5) HC[a]	(6) NO_x[a]
61. 37^{34} - 7^{43}	94.1	17.1	286.0		
62. 37^{34} - 7^{45}	36.9	6.7	110.1		
63. 37^{36} - 7^{23}	29.9	4.5	31.4		
64. 37^{36} - 7^{27}	396.2	65.3	484.7		
65. 37^{36} - 7^{31}	56.4	11.1	278.1		
66. 37^{36} - 7^{33}	187.9	32.4	279.5		
67. 37^{36} - 7^{35}	256.4	43.5	280.4		
68. 37^{36} - 7^{37}	206.7	35.5	279.8		
69. 37^{36} - 7^{39}	16.7	3.1	64.7		
70. 37^{36} - 7^{40}	20.0	3.7	65.5		
71. 37^{36} - 7^{41}	23.0	4.2	66.2		
72. 37^{36} - 7^{42}	23.0	4.2	66.2		
73. 37^{36} - 7^{43}	1013.3	287.5	1047.9		
74. 37^{36} - 7^{45}	306.6	57.6	406.4		
75. 37^{37} - 7^{39}	82.3	13.7	65.2		

[a] These pollutants have been excluded from this analysis as they will be treated on an AQCR basis.

Table A.4
1970 Pollutant Specific Emissions for Individual Grids
Disaggregated by Source:
Fulton County, Georgia

Master Grid		Part.		SO_2		CO		HC[a]		NO_X[a]	
Designation	Source	Tons/yr	%	Tons/yr	%	Tons/yr	%	Tons/yr	%	Tons/yr	%
58 37^{34}-7^{37}		49.3	100.0	10.0	100.0	1712.2	100.0				
	Residential	2.0	4.1	2.5	25.0	1.6	0.1				
	Transportation	7.7	15.6	3.0	30.0	1705.6	99.6				
	Commer./Inst.	0.7	1.4	1.0	10.0	0.6	0.1				
	Industrial	0.1	0.2	0.1	1.0	0.2	0.0				
	Solid Waste	38.8	78.7	3.4	34.0	4.0	0.2				
59 37^{34}-7^{39}		67.4	100.0	12.6	100.0	1715.1	100.0				
	Residential	2.0	3.0	2.5	19.8	1.6	0.1				
	Transportation	7.7	11.4	3.0	23.8	1705.8	99.5				
	Commer./Inst.	1.0	1.5	1.2	9.5	0.8	0.0				
	Industrial	0.8	1.2	0.7	5.6	1.0	0.1				
	Solid Waste	55.9	82.9	5.2	41.3	5.9	0.3				
67 37^{36}-7^{35}		159.9	100.0	28.3	100.0	1713.6	100.0				
	Residential	2.0	1.3	2.5	8.8	1.6	0.1				
	Transportation	7.7	4.8	3.0	10.6	1705.6	99.5				
	Commer./Inst.	1.0	0.6	1.3	4.6	0.8	0.1				
	Industrial	97.5	61.0	17.1	60.4	0.3	0.0				
	Solid Waste	51.7	32.3	4.4	15.6	5.1	0.3				
68 37^{36}-7^{37}		132.2	100.0	23.9	100.0	1713.2	100.0				
	Residential	2.0	1.5	2.5	10.5	1.6	0.1				
	Transportation	7.7	5.8	3.0	12.5	1705.6	99.6				
	Commer./Inst.	0.8	0.6	1.3	5.4	0.7	0.0				
	Industrial	73.3	55.5	12.9	54.0	0.3	0.0				
	Solid Waste	48.4	36.6	4.2	17.6	4.8	0.3				

[a] These pollutants have been excluded from this analysis as they will be treated on an AQCR basis.

Particulates are the second major emission problem in grids 58, 59, 67 and 68. Unlike CO emissions, however, the particulate emissions are attributable to more than one source. In grids 67 and 68 the particulate problem has been traced to industrial, solid waste incineration, and transportation, in that order. On the average these sources respectively account for 58%, 34% and 8% of the particulate emissions. Therefore, an adequate Air Quality Maintenance Plan would have to be aimed at all three of these sources in grids 67 and 68. Similarly, in grids 58 and 59 the particulate problem can be traced to solid waste incineration and transportation sources that respectively account for 81% and 8% of the particulate emissions. An effective particulate maintenance plan would therefore have to address both of these sources in grids 58 and 59.

The technique illustrated in Table A.4 has not been included in the procedures detailed in Volume 13 of the Guidelines because it involves a substantial effort that may not be warranted or necessary for all grid cells of an AQCR county under study. However, where large concentrations of total emissions are evident for a specific pollutant, it is strongly recommended that the user trace the cause of these emissions back to their most significant sources. Only by going through the process of obtaining results such as those illustrated in Table A.4 can Air Quality Maintenance Plans be keyed directly to specific sources of emissions.